Surface Warfare

www.surfacewarfare.nswc.navy.mil

May/June 2000

Vol. 25, No. 3

Land Attack

No Looking Back!

Land Attack, No Looking Back!

Many of us have found ourselves on the ship's bridge wing, with hearing protection donned, absorbed by the rhapsodic cycling of shell and powder from drum to muzzle. On the other hand, far fewer Surface Warriors have served on the receiving end, several miles inland, and experienced the welcomed "whoosh" of friendly ordnance passing overhead. Regardless of one's perspective, whether Sailor or Marine, naval gunfire support is an exciting evolution, which the Navy/Marine Corps team does very well.

Support of the land battle has always been an important Surface Warfare mission. From the earliest days, we've been there. We were there at Tripoli in 1805 when the Marines made their famous attack; at the Battle of New Orleans in 1814 protecting General Jackson's army with broadsides against the British left flank; and at Vicksburg in the battle for the "Gibraltar of the Mississippi." The 20th century was no exception; Normandy, Okinawa, Inchon, Hue City, Lebanon, and Desert Storm, our history is replete with naval warships on the firing line providing the fire support required to keep the enemy's heads down for our Soldiers and Marines.

But times change and advancements in technology allow us to do much more than just support the land battle; so we've expanded our range ring and captured a new mission area, land attack. Land attack complements our proven amphibious warfare capability by providing the means to decisively influence events far ashore. Supporting the Marine Corps' new operational doctrine requires advanced, longer-range precision weapons, coupled with a dynamic battle management system. We've worked closely with the Marine Corps in developing our naval surface fire requirements for DD 21. Most noteworthy was the free flowing of great ideas last November, during our first ever Fire Support Summit at Quantico, VA. Make no doubt about it, the Navy/Marine Corps team is committed to fielding, "an NSFS capability second to none" in support of OMFTS/STOM.

The key enabler and, you might say, executioner of this new warfare area is DD21, our land attack destroyer. Its healthy portfolio of weapons including the Land Attack Standard Missile (LASM), Advanced Land Attack Missile (ALAM), Tactical Tomahawk, and Advanced Gun System (AGS) with a 155mm Extended Range Guided Munitions (ERGM) round will deliver fires from the shoreline to 1500nm inland. The key piece behind successful employment of these complementary weapons is the Naval Fires Control System (NFCS), a fully joint compatible, automated fires mission processor. NFCS will receive "Calls for Fire," either electronically or by voice, conduct target analysis and weapon target pairing, and digitally send fire missions to the appropriate weapon system.

Although many of us admired the impact of sixteen-inch shells from our now retired battleships, there is no looking back. The future will bring us a capability never dreamed of on teakwood decks — we will be able to do so much more! DD 21's land attack capability represents a quantum leap above the mighty Iowa class in terms of the responsiveness, lethality and range. Just like your favorite telethon, DD 21's operators will be "standing by to accept all calls." They will accept calls for precision fires with 155mm ERGM rounds; calls for volumes of fire for operational maneuver with two battery equivalents of conventional 155mm rounds; and they will accept calls for deep strike with tactical tomahawk, hitting targets out to 1500nm with deadly accuracy. Never before has the Navy had so much to offer to decisively influence events ashore.

I can almost hear the familiar "ooh-rah" of Leathernecks cheering. Together, we have put the specter of Guadalcanal behind us forever. Land attack, no looking back!

Mike Mullen

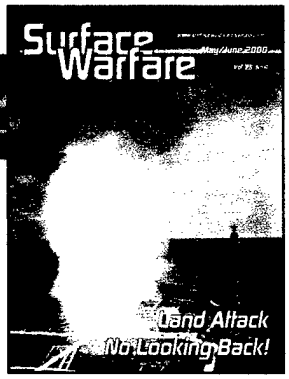
Rear Admiral, U.S. Navy

Surface Warfare

www.surfacewarfare.nswc.navy.mil

May/June 2000

Vol. 25, No.3



Focus: Land Attack

➤ On the Cover: A missile is launched from the aft deck of an Aegis Cruiser

Quarters

➤ Back Cover: A Sailor aboard USS ***Reuben James*** (FFG 57) prepares to man the rails as the ship pulls into port. (PH1 Chris Desmond/USN)

RADM Michael G. Mullen, USN
Director, Surface Warfare Division

Acting Editor
Robert F. James

Military Editor
LT Christopher B. Jennings, USN

Managing Editor
JOC(AW) Gloria L. Montgomery, USN

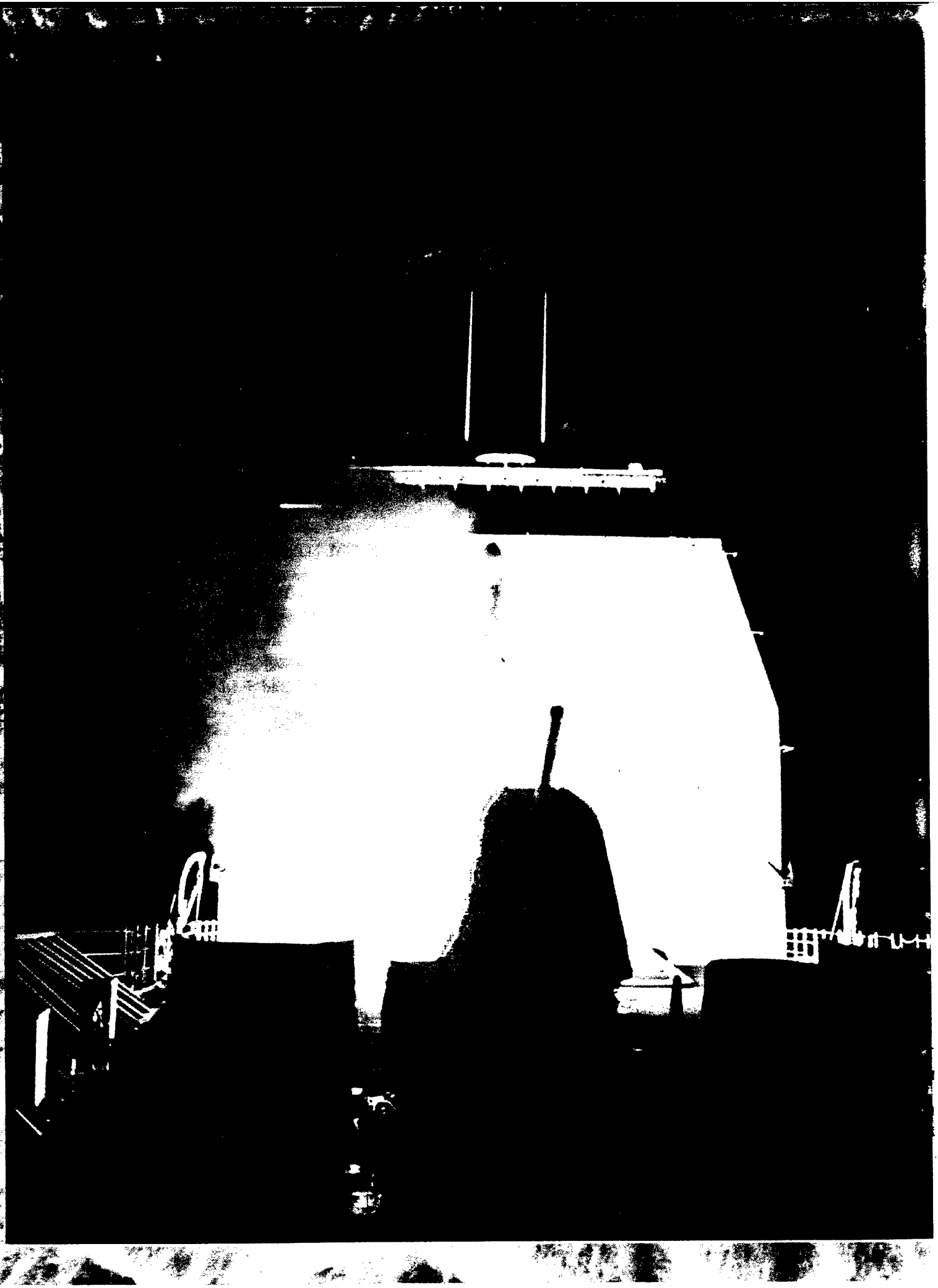
Surface Warfare (USPS 104-170) (ISSN 0145-1073) is published bimonthly from appropriated funds by authority of the Chief of Naval Operations in accordance with NPPR P-35. The Secretary of the Navy has determined that this publication is necessary in the transaction of business required by law of the Department of the Navy. Use of funds for printing this publication has been approved by the Navy Publications and Printing Policy Committee. Reproductions are encouraged. Controlled circulation. Periodicals postage paid at Arlington, VA and additional mailing offices.

Editorial:
Address editorial inquiries to:
Surface Warfare Magazine
Crystal Plaza 5, Suite 120
2211 South Clark Place
Arlington, VA 22202-3739
Phone: (703) 602-7823
DSN: 332-7823
FAX: (703) 602-7822
E-mail: surfwarmag@navsea.navy.mil

Design by Allen Wayne, Ltd.
Phone: (703) 321-7414
Toll Free: 800-695-8880
Web: www.allenwayne.com

Subscriptions
Personal (paid):
Government Printing Office
Washington D.C. 20402
(202) 512-1800

Institutional
(free/controlled):
Contact editorial offices for subscription/address changes



The advantage of sea-power used offensively is that when a fleet sails, no one can be sure where it is going to strike.

— Winston Churchill

"Fire Mission!"

Naval Surface Fire Support in the 21st Century

by CDR James E. Wise II

August 2012: A small but aggressive revolutionary state suddenly invades its mineral-rich but poorly developed neighbor. The invasion, accompanied by widespread destruction and murder, threatens to destabilize the region and provoke a humanitarian disaster. Although surprised by the speed of the advance, the U.S. Navy is not unprepared, and within a day a task group consisting of a cruiser and three destroyers is on the scene. Satellite imagery and high-altitude unmanned aerial vehicles (UAVs) paint a grim picture: A mechanized force of armored personnel carriers and soft-skinned vehicles is moving rapidly towards the defenseless capital. Using targeting coordinates provided by the UAVs, the destroyer ***Winston S. Churchill*** (DDG 81) opens fire with a 5-inch/62-caliber gun at targets 60 nautical miles away, within range of its Extended-Range Guided Munition (ERGM) rounds. The rest of the task group joins in, firing ERGMs, Land-Attack Standard Missiles (LASMs), Tactical Tomahawk (TACTOM) missiles, and — in its first appearance in combat — DD 21 with her 155mm Advanced Gun Systems (AGSs) and Advanced Land-Attack Missiles (ALAMs). Surprised by the furious and accurate bombardment and with its vehicles in flames, the attacking column breaks up and the infantry scatters in retreat.

With the invaders thrown on the defensive, the task is now to liberate the rest of the country. Soon the rest of the carrier battle group and an Amphibious Ready Group (ARG) arrives.

The Commander of the Joint Task Force (CJTF) quickly concludes that a direct assault on the dug-in enemy force will take too long and cost too many American and civilian lives. Therefore, in keeping with the new Marine doctrine of Operational Maneuver From the Sea (OMFTS), the CJTF decides to bypass the enemy's main force and seize a critical chokepoint, a bridge 75 nautical miles to the rear. Simultaneously, a second Marine force will seize the port facilities, opening the way for the follow-on echelon to break through to the force at the bridge.

At 0500 on D-Day, the surface combatants begin preparatory fires around the bridge and port, attacking every suspected defensive position and troop concentration with AGS rounds, LASMS, TACTOMs, and ALAMs. Meanwhile, tactical air units and 5-inch /62 and 155mm AGS guns pound the fixed positions of the enemy's main force 60 miles away, pinning it in position.

Two hours later, as the assault echelon gets underway, the ships begin a rapid gunfire bombardment of the objectives. DD 21's Advanced Gun Systems fire 155mm ERGM shells at a rate of 12 rounds per minute at the bridge; the other ships fire 5-inch ERGMs around the port. The barrage stuns the defenders, some of whom abandon their positions and scatter.

The assault echelons lifts off at 0700. The Marines heading for the bridge execute Ship-To-Objective Maneuver (STOM): bypassing the enemy's main defensive positions in the hills and along the occupied shore, they are airlifted in V-22 Osprey tilt-rotor aircraft directly to their objective. The Ospreys, which take off and land like a helicopter but cruise like a fixed-wing aircraft, reach the landing zones near the bridge in minutes. The second Marine force, embarked in high-speed Advanced Amphibious Assault Vehicles (AAAVs) and Landing Craft Air Cushion (LCACs), departs the ARG and travels the 25 miles to shore, again avoiding resistance and crossing the beach on either side of the port.

▼ Quartermaster 1st Class Michael Broekhof (left) and Quartermaster 3rd Class Osiris Castillo (right) plot the course of the guided missile destroyer USS ***Hopper*** (DDG 70) *(PH1 Spike Call/USN)*

As the Marines approach their objectives, the naval fires shift to strike nearby targets. The scattered defenders, because they are quickly overwhelmed by these fires and by infantry attacks, mount minimal opposition to the two Marine forces during the landings.

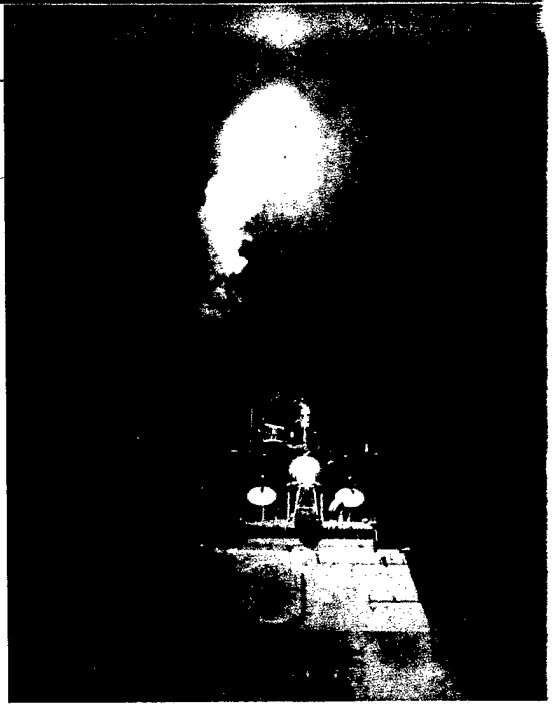
Throughout the day, the Marines are threatened by local counterattacks, but the enemy troop concentrations and vehicles are quickly spotted by Marine tactical UAVs and attacked by naval fires and the Marines' organic Lightweight 155mm howitzers. The Common Land-Attack Warfare System (CLAWS) handles requests for fire support, recommends the appropriate weapon system and assigns the targets. Within minutes of the calls for fires, the rounds strike home and the attacks are broken up, often before they can begin. The enemy attempts to bring artillery into action, but after a few rounds, the task force smothers the gun positions with counterfire. The Marines at the bridge are reinforced, and the follow-on echelons advance from the port. Cut off and threatened from front and rear, the enemy force collapses in panic. The prewar status quo is soon fully restored.

The New Requirements

This scenario is intended to show the role that Naval Surface Fire Support (NSFS) can and will have in future joint operations in the littoral regions. In recent years, the Navy has come to appreciate the importance of fire support, an issue of intense concern to the Marine Corps. During World War II and Korea, Army and Marine landings could usually count on a heavy volume of naval fires, ranging from the 5-inch guns of the destroyers to the 16-inch guns of the battleships. However, during the Cold War the Navy's attention became focussed on the blue-water Soviet threat. Its NSFS capabilities withered as shipboard guns were replaced by air-defense missiles and, later, by the Tomahawk Land-Attack Missile, a strategic weapon.

In the early 1990s, the Navy began a momentous shift in emphasis from blue-water operations to operations in the littorals. In two major white papers, ... *From the Sea* and *Forward ... From the Sea*, the Navy's leadership made clear that in the post-Cold War environment, one of the service's most critical responsibilities is to influence events ashore by peacetime forward presence, by direct power projection, by ensuring access to the littorals for joint expeditionary forces, and by actively supporting those forces in crisis and in war. "The surface navy will be an offensive maritime force," says Rear Admiral Mike Mullen, Director of Surface Warfare (N86). "From a foundation of Maritime dominance, we will ensure entry into the 21st century joint battlespace through the twin missions of land attack and theater air dominance."

The Marine Corps, too, has been adapting to the new environment of forward engagement and crisis response. Its landmark *Operational Maneuver From the Sea* concept paper defined a vision for operations that adapted the principles of the Marines' doctrine of maneuver warfare to joint operations in the littorals. OMFTS calls for the sea-based Marine Air-Ground Task Force (MAGTF) to bypass key centers of resistance, using the sea as maneuver space to move rapidly against operational objectives, while keeping the enemy off-balanced by maintaining a high operational tempo. An important corollary to this concept is Ship-To-Objective Maneuver (STOM), in which the assault echelon advances from the naval force deployed over the horizon directly against the objective — possibly as far as 200 nautical miles inland — without pausing to seize a beachhead and build up a logistical footprint ashore.



A Tomahawk cruise missile launches from the forward missile deck of USS ***Philippine Sea*** (CG 58). *(USN)*

The successful execution of STOM will depend heavily on the availability of sea-based fire support, especially during the forcible entry (assault) phase of the operation. "Of primary importance will be the close supporting fires (neutralization and suppression) in direct support of the MAGTF," observed Lieutenant General John Rhodes, Commanding General, Marine Corps Combat Development Command (MCCDC), in a 1999 NSFS requirements paper prepared for the Navy. "As we move toward Ship-To-Objective Maneuver — fire support must provide immediate and responsive high volume suppression and neutralization fires in support of highly mobile forces embarked in Advanced Amphibious Assault Vehicles, MV-22 Ospreys and Landing Craft Air Cushioned." During forcible entry, the maneuver elements will be at their most vulnerable, and supporting fires and counterfires must be accurate and lethal enough to defeat immediate threats to the assault echelon, be responsive enough to deal with unexpected threats, and have sufficient volume to suppress the threats that cannot be seen or targeted directly. "This is the most demanding phase for NSFS," Rhodes noted.

▲ Aviation Boatswain's Mate 2nd Class Donald Hynson signals to the pilots of the MV-22B Osprey that they have cleared the deck of the USS ***Saipan*** (LHA 2). *(PH1 Tina M. Ackerman/USN)*

The New Capabilities

The Navy is following a two-tier acquisition strategy to provide basic capabilities in the near term in Aegis ships and more robust capabilities in the far term in DD 21. The evolutionary near-term systems will leverage off the existing systems and technologies in the existing fleet of AEGIS surface combatants. For example, the TACTOM, a tactical version of the TLAM, will provide precision strike capability against fixed and mobile targets. The use of TLAMs for tactical purposes was shown to be practical during Operation Allied Force in Kosovo. TACTOM will improve on this capability: It will be a responsive as well as accurate weapon, with the ability to loiter over a large area and receive targeting instructions en route. Another weapon, LASM, a variant of the Navy's Standard Missile, will have a range of 150 nautical miles and will deliver its Mk 125 unitary blast-frag warhead accurately using Global Positioning System/Inertial Navigation System (GPS/INS) guidance. Both of these missiles are scheduled to achieve Initial Operational Capability (IOC) in 2003.

TACTOM and LASM will provide effective precision-strike and fire support capabilities at long ranges. However, the forced entry and subsequent phases of OMFTS operations will require fires that are not only accurate, lethal, and responsive, but also provide sufficient volume to neutralize or suppress enemy fires. This requirement calls for an improved gun and munition to replace the conventional 5-inch gun round, which has a range of only 13 nautical miles. The rocket-assisted 5-inch Extended-Range Guided Munition, which is currently under development, will have a range of 63 nautical miles and will be very accurate , thanks to its GPS/INS guidance system. The 5-foot long round will deliver 72 EX-1 dual-purpose improved conventional munitions (DPICMs), a Navy variant of the Army M-80 submunition. The EX-1 is effective against light armor, soft-skinned vehicles, and personnel. ERGM's IOC is scheduled for 2004. Meanwhile, the current 5-inch/54-caliber gun is being re-engineered to 5-inch/62-caliber and will fire both the ERGM and the conventional 5-inch shell. The first 5-inch/62-caliber gun was installed in USS ***Winston S. Churchill*** (DDG 81) in November 1999.

ERGM, TACTOM, and LASM will provide interim capabilities until the new weapon systems become available in DD 21. One of these new weapons, the Advanced Gun System, will fire 12 GPS/INS-guided 155mm ERGM rounds per minute to a range of 100 nautical miles. The 155mm round will have twice the payload of the 5-inch version and will carry DPICMS, unitary warheads, and advanced submunitions such as two Army-designed Search-And-Destroy-Armor (SADARM). Each AGS will have a fully automated magazine holding 750 rounds, permitting sustained high-volume fires equal to the throw weight of a current 6-gun 155mm artillery battery. With the increased accuracy of the 155mm ERGM, far fewer rounds will be required to destroy point targets and they will cause less collateral damage.

About the same timeframe, TACTOM and LASM will be joined by a new fire support weapon, the Advanced Land-Attack Missile. ALAM will have a range well beyond the 155mm AGS: at least 200 nautical miles, and ideally as much as 300 nautical miles. Compared to TACTOM and LASM, it will have superior performance characteristics, improved lethality and responsiveness, and an expanded target set, including armored, mobile, and hardened targets. The exact characteristics of the weapon will be determined by an 18-month Analysis of Alternatives (AoA) that began in September 1999. Initial operational capability will be in DD 21.

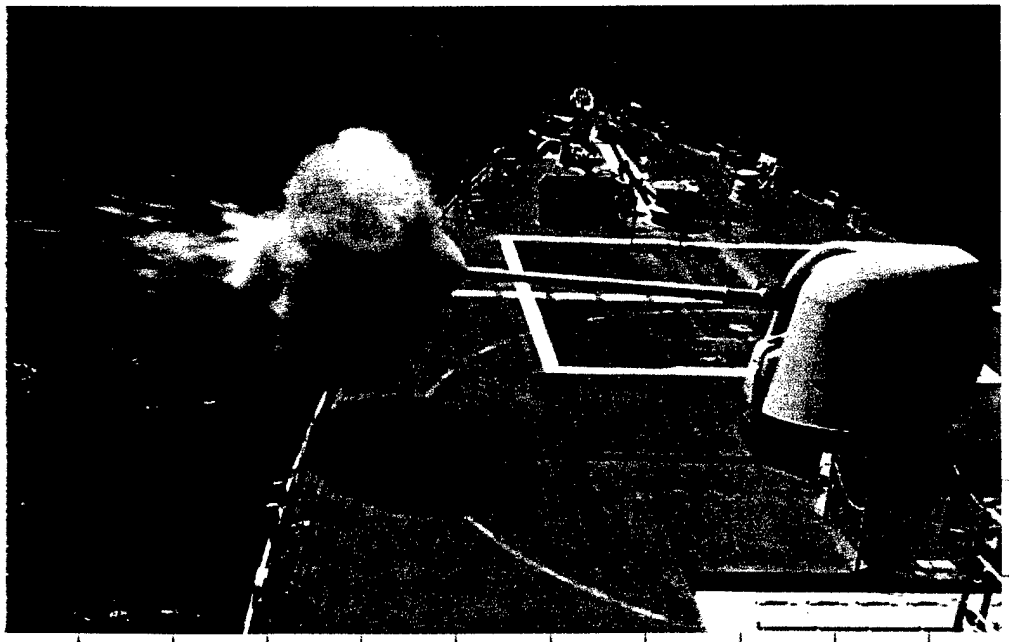
These weapons systems will represent a major leap forward — and so will the ship that will carry them: the 21st Century Land-Attack Destroyer. DD 21 will be a state-of-the-art platform for land attack and other missions. It will mount two AGSs with a total magazine capacity of 1,500 rounds — giving each ship the capability to fire 24 155mm ERGMs per minute — and will carry TACTOMs and ALAMs as well. The ship will have superior stealth characteristics and in-stride mine avoidance capabili-

ties, both of which are increasingly important in the littoral environment. It will also have a relatively small complement of only 95 sailors. It is hardly surprising that Lieutenant General Rhodes testified to the Senate Armed Services Committee's Seapower Subcommittee in March 1999 that "the continued development of the Navy's Land Attack Destroyer is absolutely critical to success in future operations."

The most revolutionary aspect of NSFS during the first decade of the 21st century will not be any specific weapon system or platform but the way fires will be requested, allocated, and delivered. The old platform-centric approach is giving way to Network-Centric Warfare, in which every ship and weapon system will become components of the larger networked force. RADM Mullen notes that "sea-based fires will be allocated dynamically from a networked-based architecture, i.e. we will use technology to distribute the real-time land and ground picture to all C2 platforms and shooters simultaneously and quickly adapt our fire support as the situation warrants." The naval task force will respond quickly and effectively to calls for fire, reprioritizing fire missions and assigning targets automatically for maximum efficiency. Fires will be massed quickly for maximum effect and redirected just as quickly to support units as small as a special operations force (SOF) team.

Key to this capability will be the Naval Fires Control System (NFCS), an automated fires mission processing system designed to support the new as well as current weapons. NCFS will receive Calls for Fire by voice or electronically (through the Army's and Marine Corps Advanced Field Artillery Tactical Data System, or AFATDS), conduct target analysis and weapon-target pairing, and digitally send fire missions to the appropriate weapon or weapons. It will also deconflict the airspace, ensuring that no friendly air assets are in the line of fire. By performing these tasks automatically, the system will shave precious minutes and seconds from the time required to respond to a call — time that could make all the difference in combat, as the Marines are quick to point out. NFCS is scheduled to achieve IOC in 2003.

▼ The Arleigh Burke class destroyer ***Benfold*** (DDG 65) fires its 5-inch/54-caliber MK45 gun. *(PH2 Felix Garza/USN)*



▲ A Tomahawk cruise missile launches from the forward missile deck of USS ***Philippine Sea*** (CG 58). *(PH1 Richard Rosser/USN)*

By about 2005, it will be subsumed under the Common Land-Attack Warfare System (CLAWS).

There are still, of course, significant challenges to be met before this vision can be fulfilled. For example, ERGM has encountered a few technical problems, but most of these have already been solved (as RADM Mullen notes, "This is as tough as rocket science!"). The Navy is continuing to coordinate with the Marine Corps to ensure that its requirements and concerns are met and to iron out certain gray areas that have appeared — because it is the Marines whose lives will hang in the balance. But challenges are inevitable in a program of this scope and ambition, and they will be overcome. Within ten years, the coming renaissance in NSFS will be in full swing and will enable the Navy-Marine Corps team to continue to lead the way in crisis-response and wartime power projection. ■

Editor's note: CAPT Wise is Head, Naval Surface Fire Support, N864G.

Now is the Time: Tomahawk Goes Tactical

by CAPT Rick Hoffman

A surface-launched Tomahawk cruise missile leaves USS ***Philippine Sea*** (CG 58). *(PH3 Renso Amariz/USN)*

As the CINC's weapon of choice in Operation Noble Anvil, the Tomahawk Cruise Missile system played an active role in Kosovo from the first strike to the end of the operation. Fired from ships and submarines, Tomahawk, the only all-weather, 24-hour weapon in the campaign, conducted strikes when NATO's tactical and strategic air forces were grounded by inclement weather. Additionally, with limited EA-6B assets already stretched to the limit, Tomahawk was the only weapon system with no requirement for suppression of enemy air defenses (SEAD) support.

Over the course of the three-month campaign, six U.S. ships and three U.S. submarines from two battle groups and one United Kingdom submarine launched a total of 238 missiles in pre-planned and quick reaction strikes. Targets engaged ranged from traditional headquarters buildings and other infrastructure targets to relocatable targets such as aircraft and surface-to-air missile (SAM) launchers. Tomahawk was effective across the spectrum, hitting 44% of all headquarters targets hit during Allied Force, 45% of all electric power targets hit, 42% of all Integrated Air Defense Systems (IADS) hit and 25% of all petroleum, oil and lubricants (POL) facilities hit with minimal collateral damage due

to precision guidance. Tomahawk was also a weapon of choice for Tier-4, high collateral damage targets and was used for 28 targets in Belgrade with no indication of ancillary damage to surrounding facilities.

In addition to strategic applications, Tomahawk was tactically effective in quick reaction strikes against relocatable targets. Building on developments implemented in Operation Desert Fox in Iraq, strike planners used preplanned missions against multiple emplacements in target areas to select the appropriate aimpoint(s) and significantly reduce reaction time once targets of interest were confirmed present. Using these strike planning and targeting tactics combined with simultaneously initializing missiles while planning/modifying and transmitting missions, timelines for confirmation of target presence to weapon on target were reduced to hours as opposed to the days common to strikes in previous campaigns. Success rates for these quick strikes against relocatable targets were equally high when compared to historical success versus strategic targets. Approximately 85% of the relocatable targets engaged were damaged or destroyed, including 2 MiG-29s, 3 MiG-21s, 1 helicopter and 15 radars, and 4 other aircraft. Tomahawks also damaged or destroyed 50% of all SAM targeting radars.

In 2003 the Navy will transition to Tactical Tomahawk (TLAM Block IV). While current Block II and III missiles will remain viable strike weapons for the current target set, Tactical Tomahawk expands our deep, precision strike capability while significantly increasing Tomahawk's responsiveness and flexibility. Tactical Tomahawk also improves our ability to defeat time critical emergent and relocatable targets ashore leading our Surface land attack effort into the 21st Century battlefield. Tactical Tomahawk meets or exceeds all performance requirements, including range, accuracy, reliability, and survivability of the current missiles in a low-cost, modernized package with a myriad of new features to facilitate engaging the expanding targets set.

Equipped with the capability to retarget in flight and to loiter over the battlefield Tactical Tomahawk will be able to respond to emerging targets as the battlefield evolves. Significantly reduced mission planning and missile initiation times, along with an ability to provide Battle Damage Indication Imagery via an onboard camera, will further enhance Tomahawk effectiveness against time critical targets. Future payload options, including penetrating warheads and smart submuntions, will further expand the weapon's target set and fill critical gaps in our current arsenal.

Tactical Tomahawk Weapons Control System (TTWCS), the shipboard segment of the weapon system, is the enabler for our improvements to Tactical Tomahawk. TTWCS will provide the ability to rapidly plan Tomahawk missions aboard surface combatants and submarines and enables the launch platform to redirect loitering Tomahawk missiles to emergent targets. Additionally, TTWCS will become the core of our future Land Attack efforts evolving to the Common Land Attack Warfare System (CLAWS). CLAWS will encompass the Naval Fires Control System (NFCS) as well as TTWCS and the LASM Fire Control System (FCS). CLAWS will be key to our land attack capabilities in the new millennium, and the CLAWS design will be optimized for improved automation and decreased shipboard manning requirements.

TTPV-Expanding Tomahawk's Target Set

As evident in recent conflicts, proliferation of buried and hardened targets drives a need to develop a cost effective, all weather, precision strike, hard target defeat capability ... Tactical Tomahawk Penetrator Variant (TTPV) fits the bill. Already a cost effective, all weather, precision strike weapon, TACTOM is the cornerstone for a hard target defeat capability in Land Attack Warfare.

While Tomahawk (and TACTOM) is an extremely effective weapon for inflicting damage on above ground fixed and semi-mobile targets, the penetration capability is limited and prevents effective employment against hardened targets. TTPV, on the other hand, is designed to penetrate and defeat hard above ground and underground high value targets. Using a kinetic energy warhead, TTPV will be capable of penetrating over three times more concrete than TLAM/TACTOM's current unitary warhead. During a sled test in October 1999, the TTPV warhead successfully penetrated a simulated concrete bunker constructed with 5000 PSI reinforced concrete with four grids of re-bar. The bare warhead successfully penetrated the target (figure 1), traveled over 1000 feet downrange, and suffered only minor scratches. The warhead design also utilizes the Hard Target Smart Fuze (HTSF). The HTSF, developed by the Air Force as a bomb fuze, has both a programmable delay and a void sensing mode. The void sensing mode allows the TPTV warhead to be programmed to explode at a specific layer of a multilayered target ... ideal for use against hardened or buried targets (figure 2).

TTPV will be the perfect complement to TACTOM, expanding the Tomahawk target set to neutralize hardened or buried targets.

TTPV is being developed by the Defense Threat Reduction Agency (DTRA) as part of the US European Command (USEUCOM) sponsored Second Counterproliferation (CP2) Advanced Concept Technology Demonstration (ACTD). The ACTD focuses on Stand-Off Attack weapons against a growing subset of the hard targets/weapons of mass destruction (WMD) related facilities. ■

Editor's Note: CAPT Hoffman is Head, Surface Strike N864F

LAND ATTACK WARFARE:

A View From a Fresh Set of Eyes

My first response after a sneak preview of what our 21st Century Land Attack Destroyer (DD 21) is probably going to look like was "Oh, what I wouldn't give to be a JO again." This new revolutionary combatant is going to be awesome.

by CAPT Brian G. Schires

For the first time, the United States Navy is enabling the creative minds of industry in a competitive venture to design our next surface combatant to meet our specific capability requirements. The industry teams competing for this contract are simply referred to as Blue and Gold. It is no secret the Gold industry team is led by Litton Ingalls Shipbuilding and a systems integrator in Raytheon Corporation and the Blue team is comprised of Bath Iron Works and a systems integrator in Lockheed Martin Corporation. There are literally hundreds of sub-contractors joining each of the industry teams adding more competition, innovative ideas, and a fresh, highly spirited approach to building a ship. This acquisition strategy is unique and reflective of the entirely new approach we are embarking upon for the good of the future fleet and the young men and women who operate it. The DD 21 acquisition strategy includes a list of Key Performance Parameters (KPP) such as: advanced naval surface fires; up to 256 vertical launch cells; significantly lower signatures than DDG 51; a crew of 95 surface warriors; and oh, by-the-way, the cost for each ship will not exceed $750 million (in FY96 dollars) by the fifth ship being built at each shipyard. So, the Navy has said, "Here is the money, here are the Key Performance Parameters (requirements), now compete to design the 21st Century Land Attack Destroyer."

It is the excitement, the anticipation of what each of the industry teams are going to present, following the Request For Proposal leading to a design selection, that makes me wish I was a JO again. Furthermore, the capabilities we are building into DD 21 will demand the sustained commitment, remarkable talent, and superior intellect of today's new breed of surface warriors. These capabilities include: the multi-function radar/volume search radar (the follow-on to our current day SPY-1 RADAR); the Advanced Gun System designed to fire 155 mm (6 inch) projectiles able to hit targets out to a range of 100 nm and with absolute (GPS/INS) precision, volume and lethality; and the Tactical Tomahawk (TACTOM). You know how good TLAM Block III is ... TACTOM (Block IV) will hit a moving target at greater range and be able to loiter in a marshall pattern until given the command to engage. Throw in built-in quality of life features, like staterooms for all and a crew size of 95 and you can quickly see why this is a revolutionary shop.

These factors, combined with the recent huge reduction in requirements during the Inter-Deployment Training Cycle, will result in much wanted (and welcomed) time for the Commanding Officer, the XO and Department Heads to train, maintain and operate their ships their way. Add-in a SWO continuation bonus, laptop computers and Palm Pilots, ten-section duty, plus a real retirement/ incentive package, and now you can understand why I wish I could be a JO again. There is a young, refreshing, competitive spirit at the highest levels within our leadership that is responding to our Junior Officers. This refreshing spirit is reflective in the gutsy "let 'em design it" acquisition business strategy for the revolutionary destroyer for the 21st Century. I am excited, I am pumped, and most of all I envy the Junior Officers in today's Navy who will one day command DD 21, LPD 17 or our other frontline ships, and have the freedom to lead and command their ships with a fresh set of eyes. As the new Branch Head for Land Attack Warfare (OPNAV N864), I hope you find this special issue of *Surface Warfare Magazine* both exciting and informative. ■

Editor's note: CAPT Shires is Head, Land Attack Warfare (OPNAV N864)

◀ LTjg Teresa Felders measures the distance between the guided missile cruiser USS ***Mobile Bay*** (CG 53) and the guided missile frigate USS ***Vandegrift*** (FFG 48). *(PH1 Spike Call/USN)*

DD 21 and the Navy's Land Attack Renaissance

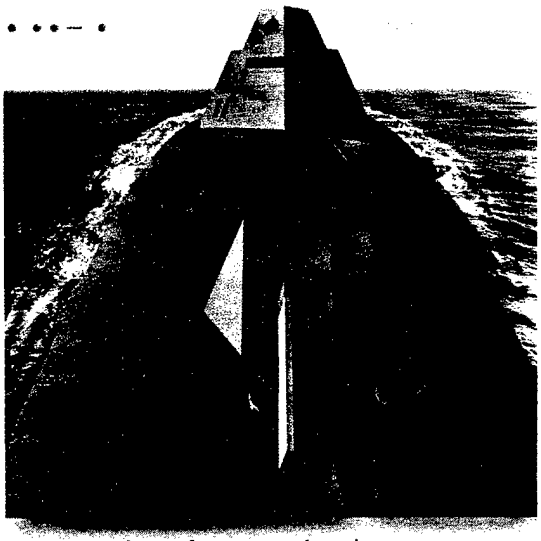
As the primary naval battlespace shifts from the open ocean to the littoral environment, the U.S. Navy-Marine Corps Team is being challenged to meet increasingly complex operational requirements, particularly those associated with engaging enemy forces ashore. Accordingly, the Surface Navy is in the midst of a "land-attack renaissance" intended to furnish the fleet with new operational concepts, revolutionary shipboard capabilities, and more capable weapon systems, with most of its power projection efforts focused on the 21st Century Land Attack Destroyer, DD 21.

by Nicole Raymond and Jon Walman

Throughout the past decade, naval expeditionary forces have been called upon to influence land campaigns with greater speed and efficacy. During Operation Allied Force, for example, the Surface Navy impressively demonstrated its ability to meet this operational demand. During the 1999 Kosovo crisis, sea-launched Tomahawk Land Attack Missiles (TLAM) struck 17 percent of all targets attacked - including 50 percent of all relocatable targets - with an 85-percent success rate. However, significant challenges and opportunities remain in the Navy's quest for more effective Naval Surface Fire Support (NSFS) against a broader set of targets - especially those that fall outside the capabilities of TLAM and other current weapons - at a reduced cost and with increased lethality.

The Marine Corps has responded to rapidly evolving littoral missions with the concept of Operational Maneuver from the Sea (OMFTS). The thrust of OMFTS is to treat the littorals as maneuver space where naval forces can exploit enemy weaknesses in support of operational objectives. OMFTS makes use of sea-based logistics and fire support, allowing the Marine Air-Ground Task Force (MAGTF) to bypass key centers of resistance and keep the enemy off-balance. Ideally, landing forces applying OMFTS will defeat the enemy's will to fight by generating overwhelming operational tempo (i.e., faster than the enemy can react) through integration of organic, joint, and combined assets. The optimum result is littoral power projection that exploits tactical mobility, enhances combat power, and offers theater and joint commanders with more warfighting options.

As one of OMFTS's implementing concepts, Ship-To-Objective-Maneuver (STOM) allows for combined arms penetration and exploitation operations directly against an over-the-horizon objective without stopping to secure a beachhead or landing zones. By sea-basing its supporting fires, a landing force can significantly reduce its vulnerability and footprint ashore, thereby improving mobility and maneuverability. STOM fire support demands highly responsive, high-volume suppression and neutralization fires in support of all landing forces.

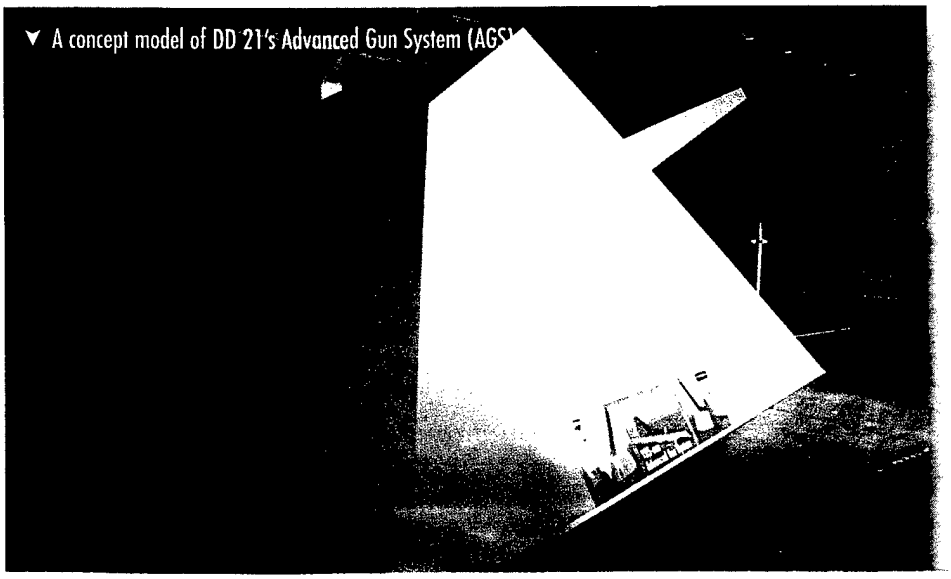


▲ Artist's rendering of a DD 21 Land Attack Destroyer concept. *(US Navy concept drawing courtesy of United Defense)*

These concepts are based upon the Navy's *Forward ... From the Sea* vision, which states: "Focusing on the littoral area, Navy and Marine Corps forces can seize and defend advanced bases - ports and airfields - to enable the flow of land-based air and ground forces, while providing the necessary command and control for joint and allied forces." Both concepts require sustainable, high-volume, and responsive sea-based fire support. To meet this demand, the Navy is developing DD 21 — a multi-mission surface combatant focused on land attack a nd designed entirely upon post-Cold War operational needs and strategic concepts such as OMFTS and STOM.

Land Attack by Design

Designed to support emerging naval and joint warfighting requirements in the littorals, DD 21 will



▼ A concept model of DD 21's Advanced Gun System (AGS)

embody an array of lethal, long-range, precision-guided munitions. The resulting "attack-in-depth" capability will provide Naval or Joint Task Force Commanders more options and greater flexibility in engaging land targets as compared to the current generation of surface fire support systems.

▼ Focusing on the littoral area, Navy and Marine Corps forces can seize and defend advanced bases — ports and airfields — to enable the flow of land-based air and ground forces, while providing the necessary command and control for joint and allied forces. (*USN*)

"Never before has a surface combatant had such a lethal mix of weapons to influence the battle ashore as is planned for DD 21," explains Captain Tom Bush, DD 21 Program Manager. "In our ever-changing world, DD 21 is the right ship, at the right time, with the right capability. It will serve as the fire support centerpiece of the Navy/Marine Corps expeditionary team for years to come."

The 21st Century Surface Combatant (SC 21) Analysis of Alternatives (AoA), completed in 1997, determined that while modifications to Aegis combatants (i.e., improved gun and missile systems through a land-attack conversion) will help close the fire support gap, it is not cost effective to modernize these ships to support all SC 21 mission needs. In essence, the AoA concluded that in order to have a more decisive role in future joint expeditionary campaigns and to support Marine Corps OMFTS concepts, surface combatants require significantly more land-attack capability - specifically in terms of magazine payload capacity, weapons flexibility, and operational affordability.

Scheduled for fleet delivery in 2010, DD 21 is being designed in accordance with the ship's Operational Requirements Document (ORD) and consistent with estimates of shipboard firepower required to prevail in a major regional conflict (MRC). There are three major subdivisions within the general land-attack mission area: strategic attack, interdiction, and fire support. Although each of these is motivated by a separate rationale, there is significant overlap among them in terms of target sets of interest and the ranges at which they need to be engaged.

Strategic attack comprises strikes intended to damage or destroy an enemy's strategic capacity for making war by holding enemy infrastructure targets at risk. The TLAM is effective against this class of target out to about 1,500 nautical miles (nm).

Interdiction strikes are intended to divert, disrupt, delay, or destroy the military potential of an enemy's land forces before they can be used effectively against friendly forces. Current requirements identify interdiction targets at ranges from 25 to 1500nm. Except for scenarios within traditional gunnery range or where TLAM can be used against support infrastructure, today's surface combatants have no means of satisfying them.

Fire support provides fires in tactical support of friendly ground units ashore, closely coordinated with the Ground Component Commander. The Marine Corps OMFTS concept defines a requirement for NSFS out to 200nm. Today's surface combatants provide fire support solely by conventional, unguided ballistic munitions shot from 5-inch/54-caliber guns with a maximum range of 13nm. The near-term modernization of Ticonderoga-class cruisers (CG 52-CG 73) and introduction of Flight IIA Arleigh Burke-class destroyers (DDG 81 and beyond) will improve the gun range (to 63nm) and accuracy of these ship's with new gun mounts (5-inch/62) and use of Global Positioning System (GPS)/Inertial Navigation System (INS) Extended Range Guided Munitions (ERGM), with an initial operational capability (IOC) of FY04.

DD 21 will support all of these aspects of 21st century land-attack warfare. Aided by advanced targeting capability, the ship will fire a mix of strike weapons and sea-based artillery to suppress enemy troops and air defenses, attack natural and man-made choke points, destroy missile-launch sites, and disrupt command and control nodes and logistics centers. NSFS operations - consisting of planned fires, emergent battlefield targets, calls for fire, and "danger close" scenarios (i.e., cases where ground forces are in close proximity to enemy targets) - will augment traditional land force artillery and thus promote freedom of maneuver by joint and combined ground forces.

DD 21 will fulfill its land-attack missions with several extended-range weapon systems capable of delivering responsive, sustainable, and high-volume fires. The heart of DD 21's land-attack arsenal is the Advanced Gun System (AGS). Currently under development by industry, the AGS will be designed to provide sustainable, high-volume fires in support of amphibious operations and the joint land battle. The system will consist of two single-barrel, trainable 155mm (six-inch) gun mounts, integrated gun and fire control systems, and automated magazines storing as many as 1,500 rounds per ship. The AGS also includes the development of conventional

munitions, as well as a 155mm version of the ERGM — a rocket-assisted precision-guided munition, more than seven feet long, with a range of 100nm. The two guns will have a combined firing rate of 24 rounds per minute.

The Navy has recently initiated an effort to develop the Advanced Land-Attack Missile (ALAM). Currently undergoing an AoA, ALAM is a surface/subsurface-launched weapon that will provide future deep-strike (>200 nm) and interdiction fire support against a broader target set than is currently possible, including armored, mobile, and hardened targets.

In advance of ALAM development, the supersonic Land Attack Standard Missile (LASM) — a variant of the Navy's family of Standard surface-to-air missiles — will have a range of 150 nm and will reach IOC in FY04. Planned as a near-term fire-support capability that will be deployed on Aegis combatants, LASM will use a Mk 125 unitary blast-fragmentation warhead and GPS/INS guidance.

An advanced version of Tomahawk, dubbed Tactical Tomahawk (TACTOM), will be capable of destroying an entire range of battlefield and theater targets, reprogramming in flight to strike targets of opportunity, and loitering over a battlefield to provide quick-strike capabilities, as well as provide real-time battle damage assessment.

In order to optimally support OMFTS and the full spectrum of operations with these land-attack weapons, tomorrow's surface forces must also attain information superiority over potential adversaries. In future joint warfighting conflicts, sea, air, and land forces will be required to gather and share information used to create dominant situational awareness and to rapidly identify and engage enemy targets ashore, including those which are mobile and relocatable. With direct, fire-control-quality links to a wide range of shipboard and off-board (theater and national) sensors, DD 21 will support network-centric warfare and contribute significantly to the information superiority called for in the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010* policy document.

These weapons and information superiority capabilities, carefully engineered at the total ship system level and embodied in DD 21, will provide the sensor-to-shooter connectivity needed to attack enemy forces in depth. The combination of rapid maneuver and sustained, high-volume, and responsive precision firepower, as described in OMFTS, is intended to overwhelm adversaries who cannot keep pace with the high operational tempo generated by U.S. forces.

Time-Critical Strike

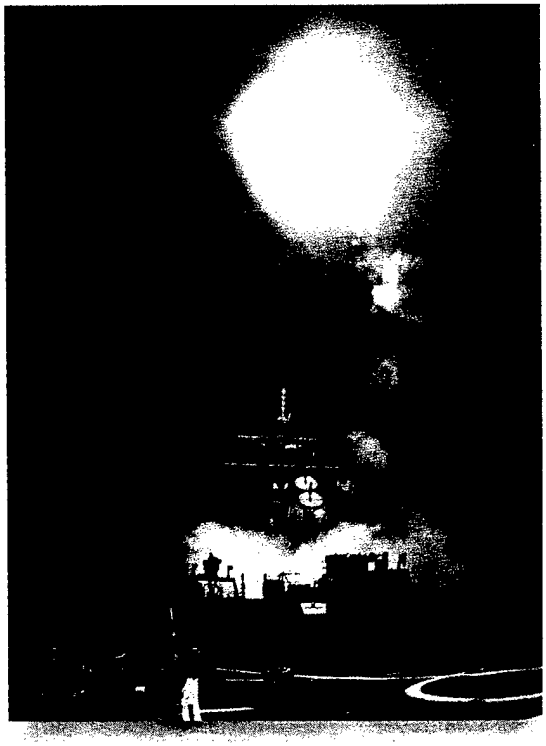
Partly due to recent joint/combined operations like Allied Force, Navy leadership has placed more emphasis in the area of time-critical targeting/time-critical strike - now one of the service's top 12 Future Naval Capabilities (FNC).

According to Director of Surface Warfare Rear Admiral Michael Mullen (N86), "With the introduction of the MV-22 Osprey tiltrotor aircraft into the fleet, the Marines will be conducting STOM missions out to 200 nm. In that regime, they will not have organic artillery and will have to rely on long-range, responsive, accurate, and lethal fire support from Navy warships."

DD 21 will manage "call for fires" through shipboard and off-board mission planning, command and control (C2), and target acquisition systems fully networked between in-theater naval and joint forces. Advanced information processing, integrated tactical displays, and other optimal manning initiatives will provide new levels of automated onboard fusion and interpretation.

The Naval Fires Control System (NFCS), an automated fires mission processing system intended for Aegis combatants, will receive calls for fire either by voice or electronically through the Advanced Field Artillery Tactical Data System (AFATDS), conduct target analysis and weapon-target pairing, and send fire missions digitally to the appropriate weapons. NFCS is scheduled to achieve IOC in 2003.

A Tomahawk cruise missile launches from the aft missile deck of USS *Gonzalez* (DDG 66). *(PH3 Renso Amariz/USN)*



tive communications and battlespace surveillance, as well as responsive and distributed firepower between all ground support elements. "As the trend in future precision-guided weapon development leads to further extension of the ranges at which battle is joined, the most significant challenge becomes reducing the gap between the sensor's discrimination of a target and the shooter's engagement of that target," explains Mullen. "This puts pressure on technological development. Time-critical targeting at highly mobile enemy assets, such as armor or troop formations, pressurizes the land attack side of combat."

◀ LTjg Chris Reardon and LTjg Todd Snyder receive information on area movement inside USS *Philippine Sea*'s Combat Information Center. *(PH3 Renso Amariz)*

Other Key Performance Requirements

Establishing and maintaining maritime dominance in operationally complex littoral environments is critical to the success of land-attack operations. DD 21 and its accompanying task forces must control the littorals in order to extend the battlespace inland. To achieve maritime dominance, DD 21 will provide multi-sensor coverage on, above, and underneath the sea through a network-centric warfare concept of operations that effectively integrates and intuitively processes advanced command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems from all in-theater assets. Once a coherent tactical picture at sea is established, the DD 21 crew will be able to focus its attention on operations ashore.

To ensure safe operations in littoral regions, DD 21 is also being designed with cutting-edge survivability features, such as full-spectrum signature reduction (i.e., stealth), robust self-defense systems, reconfigurable ship systems, and in-stride mine avoidance capability. In addition, DD 21 will feature a revolutionary integrated power system architecture with electric-drive propulsion, offering significant fuel and maintenance savings and unprecedented advances in warfighting capability.

Navy officials are ensuring the affordability of DD 21 class by limiting the ship's life-cycle engineering and support costs. One way to minimize operations and support costs is by optimizing crew size through automation. The Navy and its industry partners are introducing a "human-centered" design approach that focuses on the early system design, engineering, and integration of hardware, software, and the Sailors who will serve aboard DD 21. Human systems integration also addresses quality-of-life innovations to improve shipboard habitability, reduce maintenance workloads, and enable DD 21 crews to focus on professional development and warfare proficiency.

Military operations that have occurred over the past decade, from Operation Desert Storm to Operation Allied Force, highlight the value of surface combatant land-attack capability in support of joint, multi-service campaigns. The revolutionary systems, weapons, and warships, such as the 21st Century Land Attack Destroyer, currently under development will allow the United States to deter conflict, or, if necessary, deliver devastating strikes from the sea against a future adversary. ■

Editor's Note: Jon Walman and Nicole Raymond are Public Affairs for PEO Surface Strike.

Program Executive Office for Surface Strike Reorganizes, Hamilton Takes the Helm

The Program Executive Office for DD 21, PEO DD 21, was recently reorganized and redesignated the Program Executive Office for Surface Strike, PEO (S), at the direction of Assistant Secretary of the Navy for Research, Development, and Acquisition Dr. Lee Buchanan on 20 January. As part of the reorganization, two Memoranda of Agreement (MoA) have been signed. One transfers execution responsibility of the Naval Surface Fire Support (NSFS) Program from the Program Executive Office for Theater Surface Combatants, PEO TSC, to PEO (S). The other MoA assigns execution responsibility of the Advanced Land Attack Missile (ALAM) Program to PEO (S) and outlines the working relationship between PEO (S) and the Director, Strategic Systems Programs. The naming of PEO (S) and reorientation of surface strike acquisition programs reflect the Navy's increased focus on coordinated land attack capabilities.

The NSFS Program (PMS 529) is responsible for the development, procurement, and maintenance of responsive, lethal, and flexible NSFS combat systems, which satisfy fleet operational requirements. Some of the major weapon systems it manages include the MK45 Mod 4 Gun Mount, the 5" EX-171 Extended Range Guided Munition (ERGM), and the Naval Fires Control System (NFCS).

The ALAM Program (PMS 520) will develop and deploy a highly responsive missile with longer range and more lethality than the near-term Land Attack Standard Missile (LASM). The requirement for this robust, all-weather missile is to engage fixed and time-critical relocatable targets beyond 200 nm from the ship. The Navy plans to integrate ALAM into the DD 21 System with potential for backfit on both submarines and Aegis combatants.

Other programs assigned to PEO Surface Strike include the DD 21 Land Attack Destroyer Program (PMS 500), the Integrated Power System (PMS 510), and the Affordability Through Commonality Program (PMS 512). PMS 500 also manages several DD 21 weapon subsystems, including the Advanced Gun System, the Multi-Function Radar, and the 21st Century Integrated Undersea Warfare (IUSW-21) effort.

On 25 February 2000, Captain Charles Hamilton was named interim PEO (S). He relieved Ray Lisiewski who has resumed his duties as Deputy PEO (S). Captain Hamilton was most recently assigned to PEO TSC where he was responsible for Fleet Introduction and Life Cycle Engineering and Support of all in-service surface combatants. He is also the former Arsenal Ship Program Manager. RADM Joseph Carnevale, Jr., led PEO DD 21 for two years before departing in February 2000 to become the CINCLANTFLT Maintenance Officer.

Under the leadership of PEO (S), the Navy and its industry partners are working together to ensure that DD 21 and other surface strike systems are delivered to the fleet on time and on budget. ■

Surface Combatant Advanced Technology – Not Just For DD 21

by CAPT Scott Anhalt

DD 21, the Navy's new 21st Century Land Attack Destroyer, is being developed and designed as the first surface combatant founded entirely on both the mission requirements and the technological advances of the 21st century. Key to this platform are leading edge revolutionary capabilities including a dramatic, innovative hull form and topside design for reduced signatures, the first Integrated Power System on a U.S. Navy Combatant, an Advanced Gun System, an advanced Multi-Function/Volume Search Radar suite, the next generation Land Attack missiles, and a totally integrated ship computing architecture.

DD 21's primary mission areas of land attack and maritime dominance emphasize the United States Navy's shift from a blue water to a littoral strategy as outlined in such Military policy documents as the Navy's *Forward ... From the Sea,* the Marine Corps' *Operational Maneuver From the Sea,* and the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010.* DD 21 design reflects this shift in strategy through the incorporation of new technologies funded under research and development programs that emphasize precision firepower and seamless interoperability. The maturation of these new developments is key to influencing events ashore and dominating the littoral battlespace.

DD 21 is not the only shipbuilding program slated to benefit from these technologies. DD 21's unique acquisition strategy and total ownership cost goals impart a dramatic change in how the U.S. Navy will design and build warships in the 21st century. DD 21 design efforts and advanced technology programs spearhead the Navy's plans for future warships, while positively impacting technology backfits to existing ships.

Depending on their specific requirements, future Navy warship classes can be expected to have technologies similar to those on DD 21 including enhanced stealth characteristics, multi-function apertures, reduced crewing, and electric drive propulsion systems. Platforms such as the Joint Command and Control Ship (JCC(X)), the Auxiliary Dry Cargo ship (T-ADC(X)), CVN 77 and follow-on CVN(X) aircraft carriers, the LHD(X) amphibious ship, the CG 21 cruiser (proposed replacement for the TICONDEROGA (CG-47) class Aegis cruisers), even future submarine classes, all benefit from research and development efforts ongoing within the DD 21 program. Ships currently under construction such as LPD-17 and DDG-51, as well as those scheduled for major upgrades through the Cruiser Conversion Program also expect benefits from DD 21 technological upgrades. What follows are some of the more dramatic and important research and development efforts.

Integrated Power System (Electric Drive)

The Secretary of the Navy's January 2000 announcement that DD 21 will have an Integrated Power System has a tremendous impact on future warship construction. Advances in power electronics now make it possible to build a high-performance, integrated power system that will revolutionize future shipbuilding as did the steam engine in the mid-1800s. This evolutionary technology enables an electric motor to directly power a ship's propeller making the ship design much more flexible. Eliminating the reduction gears and lengthy propeller shafts makes valuable internal space available for additional weapons systems and more comfortable crew living quarters. Greater flexibility in ship design also enables new placement of critical propulsion train components away from the hull to areas less susceptible to threat weapons, improving the survivability of the ship. Integrated electric propulsion also facilitates quieter operation, and the associated integrated power system provides for better power distribution allowing ships to support more powerful weapons, sonar and radar systems. The integrated power system also has a very positive effect on propulsion system efficiency and fuel economy. While the Navy has put electric drive on small survey vessels, DD 21 would be the first modern warship to incorporate this technology.

Future Navy ships are expected to take full advantage of the lessons learned from DD 21's experience with an integrated power system, including the future LHD(X)-class amphibious ships and CG 21 class cruisers. The Navy's Joint Command and Control ship (JCC(X)) program may also consider this technology. Finally, the design of the integrated power system allows acoustic noise reduction, making it particularly attractive to the submarine community.

Signature Reduction

The unique notional DD 21 hull form is a dramatic visual representation of the vastly reduced signatures envisioned for this combatant. As the first U.S. warship to incorporate an integrated approach to signature reduction, DD 21 is the critical

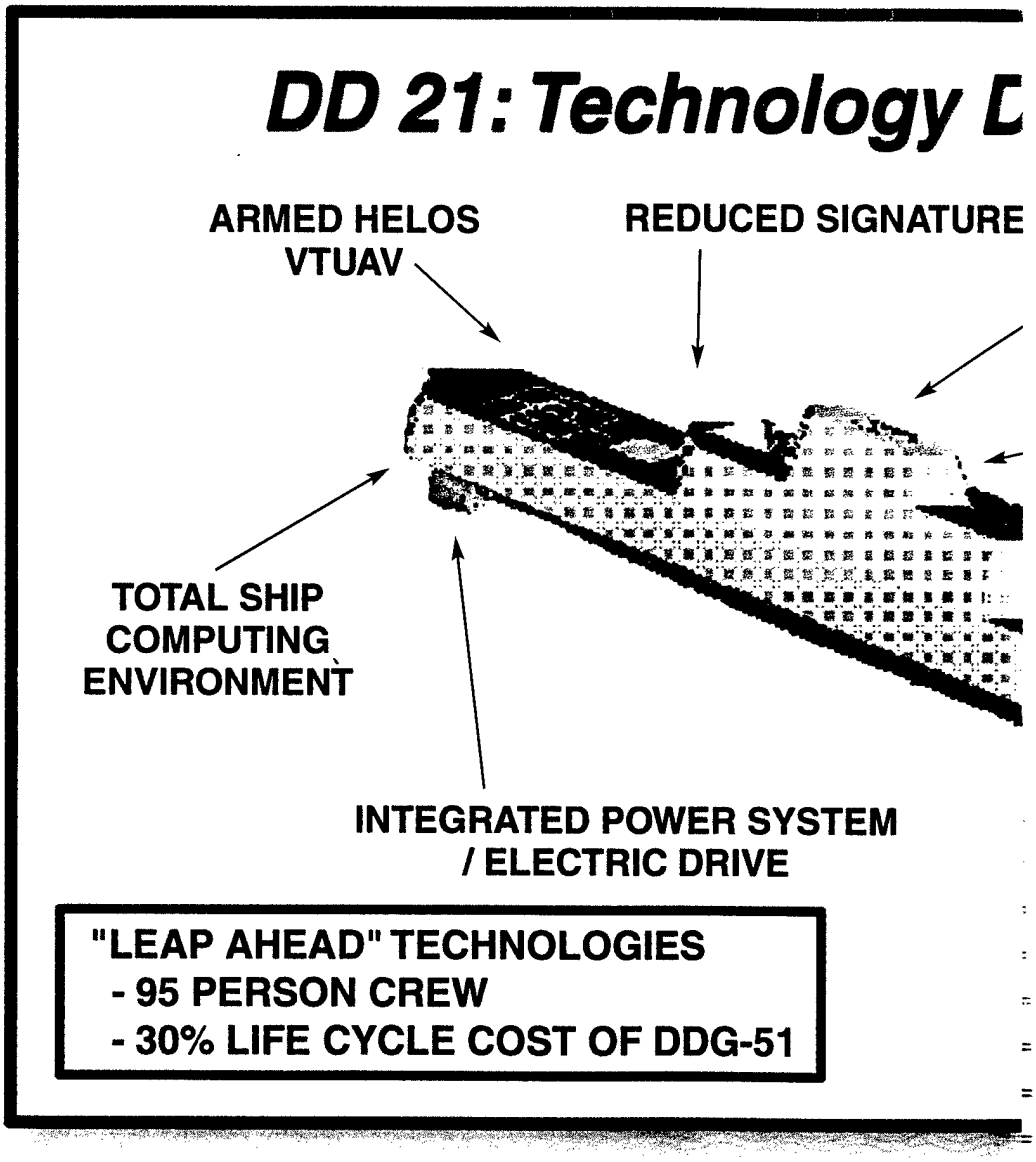
bridgehead for development of these technologies. With U.S. strategic and tactical concepts requiring increased operations in the littorals, future platforms will be expected to operate closer to shore than ever before, placing our forces well within range of anti-ship cruise missiles, conventional submarines, and mines. Within the context of this new environment, reduced signatures, combined with a robust self-defense capability, can assure the required survivability for the fleet of the future. With its land attack focus, DD 21 incorporates stealth to guarantee its survival while conducting offensive operations close to shore.

While specific types of signature-reducing technologies will not be disclosed until the Navy downselects to one industry team ship design concept in 2001, requirements to reduce DD 21's radar signature necessitate an integrated topside design (i.e. reduced signatures through the use of an advanced superstructure incorporating embedded multi-function apertures for antenna and electronic systems). The ship design will also likely include radical composite construction materials, some radar absorbing materials, and optimized hull shaping both above and below the waterline. Extensive attention will also be given to acoustic quieting and degaussing for both equipment and propulsion systems. The integrated power system is expected to provide substantial quieting capability.

Multi-Function/Volume Search Radar Suite

A focal point for DD 21's Integrated Topside Design and embedded aperture technology is the Multi-Function Radar (MFR), which is being designed and developed as an Engineering Development Model (EDM) by Raytheon Systems Company, Sudbury MA. It is a solid-state, active array radar system that will not only scan the horizon for high-speed, low-level cruise missile threats, but also provide fire-control illumination for DD 21 air defense weapons. Supplemented with a Volume Search Radar (VSR), being developed within the DD 21 competition, the radar suite will provide capabilities including situational awareness, air control, track identification, and counterbattery detection.

Like the integrated propulsion system, DD 21's radar suite will have broad applications for other future naval platforms. The preeminent among these is CVN 77, which will be the first ship to field the Mult-Function/Volume Search Radar suite. Currently, both the DD 21 and CVN 77 Program Offices are working closely together to ensure requirements for both platforms are being incorporated into the radar suite design. This technology should also interest the designers of JCC(X) and LHD(X), as well as platforms currently in construction (such as LPD 17).



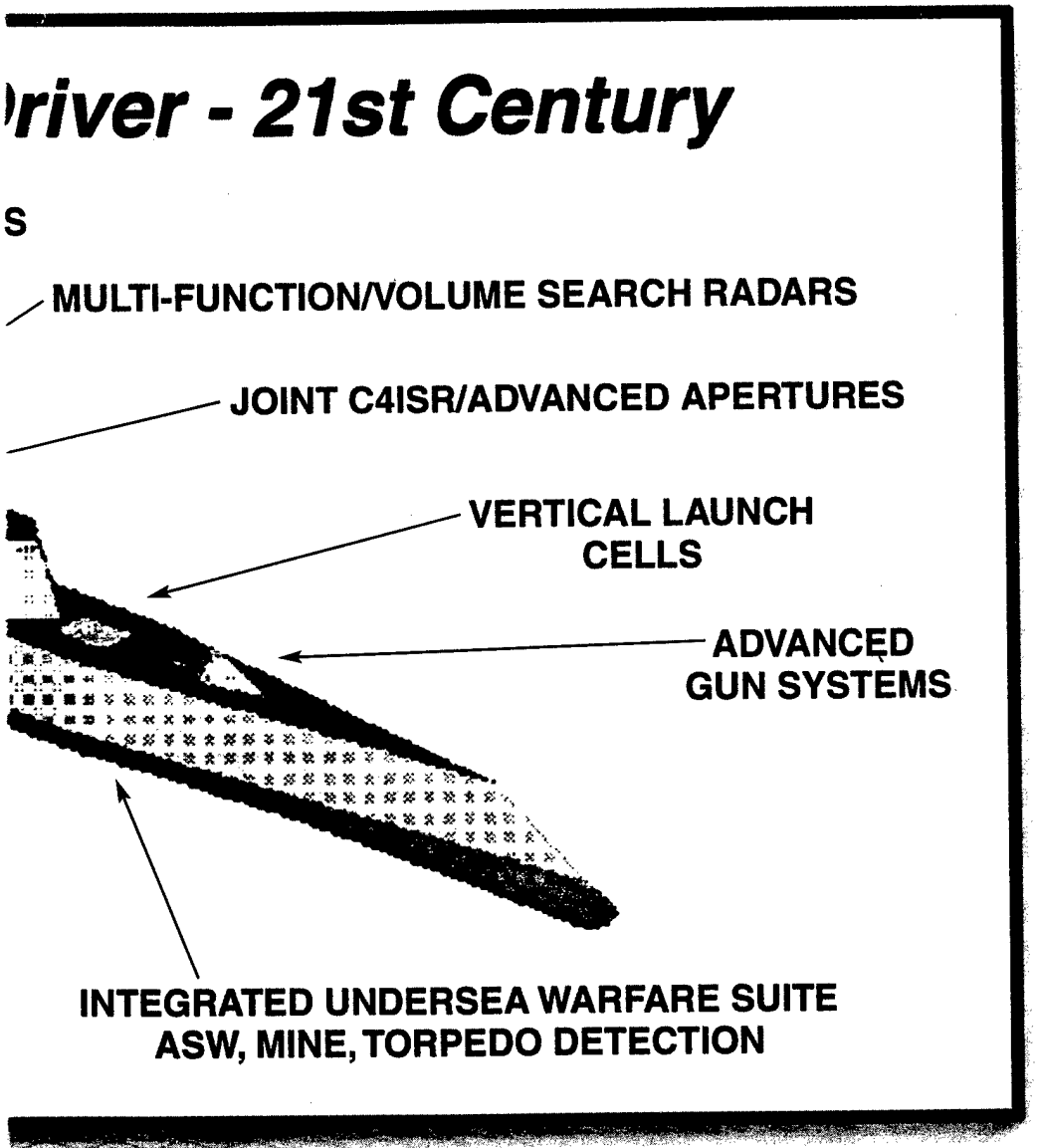
Advanced Gun System and Associated Munitions

With fully automated magazines, Extended Range Guided Munitions (ERGM), and the equivalent of two USMC M198 155mm Howitzer

Batteries in firepower, the two Advanced Gun Systems (AGS) in DD 21 will radically influence all future naval gun developments. The vision for a littoral warfare strategy requires a system capable of providing effective and sustained Naval Surface Fire Support (NSFS) for amphibious operations and joint land battles. AGS will provide the needed accuracy, range, responsiveness, and volume of fire to fully meet the Navy's NSFS requirements.

AGS will employ 155mm caliber munitions capable of hitting targets accurately up to a distance of 100 nautical miles. Associated with the gun are gunfire control functionality integrated into the DD 21 Total Ship Computing Environment (TSCE), an automated magazine, and low-radar and IR signatures for the gun and barrel. AGS design includes a family of 155mm extended range guided projectiles with warheads matched to the projected land attack target set. Efforts are underway to achieve as much commonality as possible with U.S. Army 155mm projectiles.

Beyond its role on DD 21, AGS may someday serve as a model for future large caliber naval gun systems. Indeed, AGS requirements demand the most capable naval gun system ever produced, its extended range dwarfing the range of the 5"/54 Mark 4 mod 2 guns currently found on U.S. surface combatants. In addition, the expected projectile weight for the AGS munitions is much larger than that of current guns. Other revolutionary capabilities being developed in conjunction with AGS include state-of-the-art materials, and advanced barrel cooling methods. Finally, future lethality enhancements may include a penetrating capability that will certainly improve the warfighting capability of DD 21 and any other 21st century combatant.

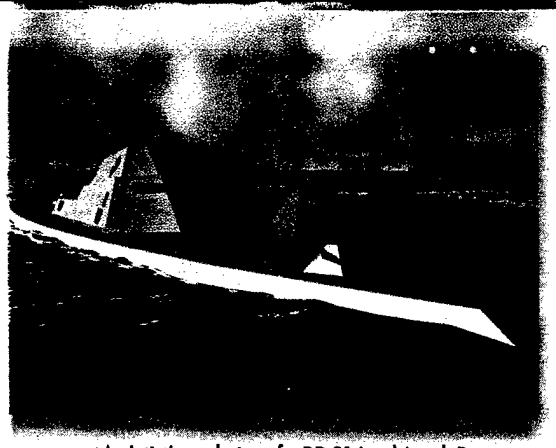


Optimized Manning

DD 21's objective for a 95-person crew is perhaps the most revolutionary aspect of its design. It represents a dramatic decrease from the crew of an Arleigh Burke-class destroyer, affecting almost every characteristic of the ship, from its weapon and sensor systems to habitability facilities. The automation that makes this crewing reduction possible will improve warfighting capabilities and the Sailors' quality of life.

The Navy's primary research and development thrust is to automate as many functions as possible (and affordable), leaving the warfighter to focus on those areas where human intelligence and skills are indispensable, such as planning options and decision-making. New systems such as the integrated power system, MFR, and AGS are being designed to free Sailors from the mundane and routine. An integrated power system on DD 21, for example, would require fewer prime movers and mechanical sub-systems than a conventional propulsion system and should reduce ship engineering staff by a significant amount.

DD 21 crewing requirements are also being addressed through simplifying the understanding and operation of shipboard displays. Sensors, intelligent interfaces, and automated systems assume greater responsibility for damage control monitoring and response. In a casualty situation, these technologies will not only be capable of rapidly



▲ Artist's rendering of a DD 21 Land Attack Destroyer concept. *(US Navy concept drawing courtesy of United Defense)*

detecting and responding to such problems as smoke, fires, and flooding, but their detection capabilities will save valuable time that might otherwise be spent having a damage control team assess the damage.

One developing technology being considered is known as Remote Sensing through Virtual Presence (RSVP). RSVP improves shipboard situational awareness by monitoring the location and condition of crew members through a tracking device each Sailor and Officer would wear. In a damage control situation, RSVP would allow rescue parties to know the precise location and condition of crew members in need. Future warship platforms can take similar top-to-bottom design approaches and build on the manning optimization efforts of DD 21. Many of these new developments can also be applied to current platforms to enhance warfighting capability and ease crew workload.

A New Approach to Acquisition

Historically, forty to sixty percent of the total life cycle cost (LCC) of a surface warship has been spent on training and maintaining a crew. With its 95-person manning requirement, DD 21 strives to meet its objective of achieving an Operating and Support (O&S) cost of $2,700 per hour underway, or approximately 70 percent less than similar costs for the ARLEIGH BURKE class.

Contributing to the cost control, the DD 21 program is using a Full Service Contracting (FSC) approach to acquisition. Under FSC, the industry team selected to design and build the ship will also have major responsibilities throughout the ship life cycle, including maintenance, logistics, and crew training. The competing DD 21 industry teams were brought into the acquisition process much earlier than previous combatant shipbuilding programs. This provides them a larger trade space over which to optimize cost with innovations that affect the entire life cycle of the program.

The DD 21 FSC concept is representative of a growing trend in which the military is reducing its infrastructure costs through greater reliance on industry. As the most comprehensive example of industry involvement to date, the DD 21 FSC experience will be closely watched by future naval planners and designers.

Under the FSC approach, the contractor is required to monitor, analyze, and support the ship wherever it is deployed. Each DD 21 ship is envisioned to have on-line access to such services as training, maintenance, and logistics. Ongoing initiatives such as Anchor Desk may test the feasibility of a number of potential manpower savers such as replacement part requisitions being transmitted automatically, suppliers delivering parts directly to the ship, and subject matter experts on-shore complementing the skills of the crew through real-time communications reach-back.

The final DD 21 design is expected to reduce life cycle costs by including an open-system architecture with common standards and interfaces for everything from command and control to engineering. The goal is to simplify modifications or reconfigurations of any ship hardware, lowering operational costs and minimizing manning requirements. To make shipboard software more reconfigurable, the Navy envisions DD 21 having a Total Ship Computing Architecture based on commercial computer standards for interfaces, services, and supporting formats. To enable computer components to be used across a wide range of systems with minimal changes, the Total Ship Computing Architecture will also provide for rapid and cost effective software development, upgrade, and integration.

Navy planners and designers responsible for future warships are looking closely at the cost cutting measures and particularly at the acquisition strategy used in developing DD 21.

The Future

DD 21 is the cornerstone of a revolution in shipbuilding, design and new technologies. From hull-form and superstructure to weapon systems and design strategy, DD 21 represents a dramatic break with the past while spearheading a new path for the future. It is the first Navy ship being planned and built from the keel up to respond to the changing mission requirements of the 21st century and it will meet those requirements by taking full advantage of significant technological advances. DD 21 serves as a technological pathfinder for future ship acquisitions. These next-generation ships and sailors will share many of the same requirements and benefit from the advanced technologies now being developed for DD 21. This will enable them to meet the evolving and uncertain threats the United States will face in the decades to come. ■

Editor's note: CAPT Anhalt is Head, Future Ships/Systems, N864D.

Naval Sea Systems Command's Naval Surface Warfare Center, Dahlgren Division has a long history enabling the surface Navy to "influence events ashore." Ours will be a Navy which can "directly and decisively influence events ashore—anytime, anywhere. By helping translate the operational context and defining the architecture for leveraging the latest in commercial technology, the capability to execute widely varying Land Attack missions in preparation for and in support of operations by naval, joint and coalition forces ashore soon will be reality.

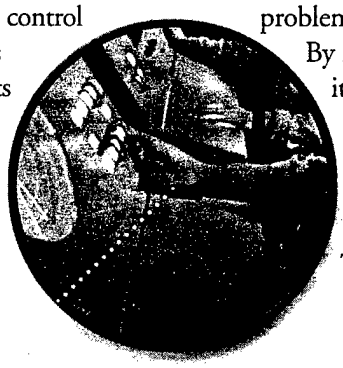
Efforts are underway at Dahlgren as well as other Navy technical activities, FFRDCs and defense contractors to develop and field the weapons systems and associated planning, targeting and coordination systems that will make his vision a reality for tomorrow's warfighters. None of us can do this by ourselves. It takes all parties working in close cooperation to deliver this much-needed capability to the Sailor of the future.

— CAPT Vaughn E. Mahaffey,
Commanding Officer, NSWCDD

A COMMON LAND ATTACK WARFARE SYSTEM FOR AEGIS COMBATANTS

BY LAURENCE C. WEEKS

With the breakup of the Soviet Union, the Navy's once primary mission of defending the open oceans from the Soviet threat has been refocused on the ability to project power ashore from the sea – anytime and anywhere. In 2003 the Navy will introduce the first in a series of enhanced land attack weapon systems on Aegis ships to complement the existing strategic Tomahawk cruise missile and 5-inch/54-caliber gun capability. The first enhancement is the introduction of a tactical version of the Tomahawk missile with a range of over 1500 NM. This capability will be followed in 2004 with a supersonic Land Attack Standard Missile (LASM) with a 150 NM range, along with a gun-launched 63-nautical mile (NM) Extended Range Guided Munition (ERGM). These new land attack gun and missile weapons will utilize the Global Positioning System to provide all-weather, highly accurate and lethal fires. In conjunction with the combat system and weapon control systems, these new weapons will enable Aegis combatants to provide responsive, sustainable, coordinated and synchronized fires across multiple platforms as a key part of the joint land battle.

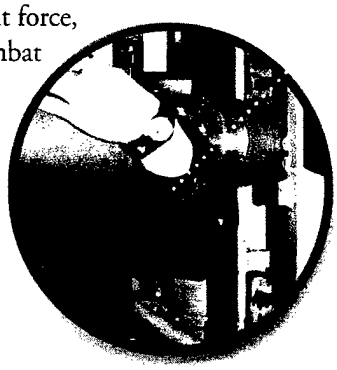


To fully realize these new Land Attack capabilities, corresponding advances are required in theater and platform command, control, communications, computers, intelligence, surveillance, reconnaissance and targeting (C4ISRT) systems across numerous program offices. This document summarizes the vision of a fully integrated Common Land Attack Warfare System for Aegis combatants to support the joint land battle. The goal is to create a Land Attack Warfare mission area equivalent to that of Air Dominance or Maritime Dominance.

COMMON LAND ATTACK WARFARE SYSTEM (CLAWS)

CLAWS will consolidate weapon system and weapon control system specific Operational Requirement Documents, along with numerous requirement papers and publications that cover various portions of the surface combatant land attack warfare problem, into a unified system. By leveraging the functionality of the Aegis Combat System, the Naval Fires Control System (NFCS), the LASM Fire Control System, and the Tactical Tomahawk Weapon Control System (TTWCS), CLAWS will provide an integrated command and control, information management, tactical picture management, planning, targeting and execution system for engaging land targets. The driving force behind CLAWS is to meet the joint force and ground commander's firepower and responsiveness requirements while maintaining and preferably reducing the manpower required to safely perform the land attack functions on board ship.

CLAWS will encompass the missions of Naval Surface Fire Support (NSFS), suppression of enemy air defenses, interdiction, and strategic attack. All land attack weapons (gun projectiles, LASM, and Tomahawk), as well as future nonlethal assets, will be available to support strategic, operational, or tactical land attack warfare objectives. To support these missions and levels of warfare, CLAWS must be capable of receiving and utilizing all applicable joint force, Navy, and combat system information for situational awareness, coordination, synchroniza-

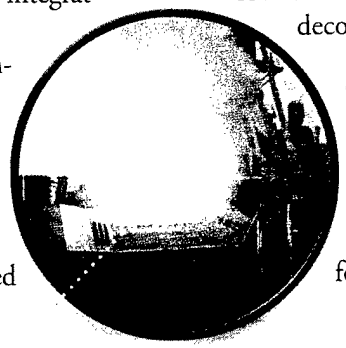


tion, and deconfliction. Although full digital connectivity between all land attack assets is the goal, voice communications will be retained as a backup capability.

To meet the vision stated in this document, CLAWS must be fully integrated with the Aegis Combat System. Surface combatant operational requirements have consistently stressed responsiveness, lethality, sustainability and affordability across all warfare mission areas. These requirements - along with increased emphasis on reduced manning, faster land attack mission response times, and coordination and synchronization with other joint fires - mandate a highly automated and integrated CLAWS solution. CLAWS will provide the commanding officer and combat information center personnel a flexible and responsive war fighting capability fully interoperable with the ship's other warfare areas, as well as both Navy and joint mission areas.

Because Aegis Baseline 6 will continue the migration to commercially developed displays, processors and peripherals in an open-system distributed architecture (to be completed in Baseline 7), CLAWS will notionally be a software integration of the currently separate land attack subsystems. An advantage of the distributed architecture is that these various subsystems can be physically located anywhere on the network.

CLAWS will be Defense Information Infrastructure (DII) Common Operational Environment (COE) compliant. As such, CLAWS will notionally consist of ship- independent functional segments integrated by an overarching ship-dependent segment that communicates with the Aegis Combat System over a defined interface. This implementation strategy will allow all of the ship-independent modules to be reused on non-Aegis platforms. This concept will also enable the rapid insertion of technology, packaged in DII COE segments, as it becomes available.



Surface Combatant Roles

For each level of warfare (strategic, operational, or tactical), CLAWS must be capable of supporting the combatant in a dependent, independent or coordinating operational role.

Dependent Unit

In the dependent role, the ship is subordinate to a joint fires coordination center that provides planning, coordination, deconfliction and fire missions. Battlespace deconfliction is performed off board, and the ship is responsible only for local area deconfliction.

Independent Unit

For the independent role the ship is either the 'first to arrive on scene' or 'last to leave the scene'; thus no higher level on-scene commander or joint fires coordination center is available. The ship conducts fire missions from received calls-for-fire, or will originate missions acquired by organic and off-board targeting sensors in accordance with the joint force commander's guidance. The ship performs all coordination and local/battlespace deconfliction.

Coordinating Unit

When assigned, the ship acts as the coordinating unit for several fire support units in accordance with the joint force commander's instructions. The ship pairs weapons and firing units to spotters and targets, and performs both local and battlespace deconfliction.

Targeting Information

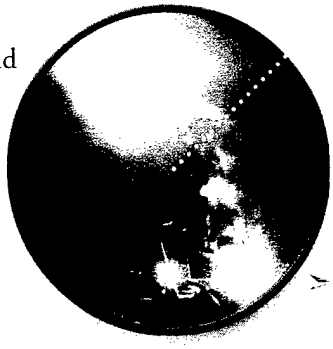
The combatant will provide fires to meet both the joint force commander's strategic and operational level objectives and the ground component commander's tactical fires support objectives. For tactical and operational fires, joint fires coordination centers will designate target objectives to the ship for destruction or neutralization.

If required, the ship will utilize organic sensors and communicate directly with non-organic sensors to develop targeting quality information to execute missions against target lists received from the coordination centers. Organic sensors include the AN/SPY-1 radar (for counterfire), electro-optic sights, and the Vertical Takeoff Unmanned Aerial Vehicle (VTUAV). Non-organic sources will include tactical and theater UAVs, the Joint Surveillance and Targeting Attack Radar System (JSTARS), various reconnaissance aircraft, space-based, and ground-based sensor systems. In areas where joint fires coordination has not been established, the ship may be required to perform target detection, classification, selection and acquisition in accordance with the joint force commander's guidance.

To support the coordination and synchronization of joint fires, future communication systems must leverage evolving technologies, programs and joint service initiatives. Land attack communication systems must provide reliable, high-bandwidth, over-the-horizon, sensor-to-shooter, and command and control connectivity.

Land Attack Weapons and Support Systems

Aegis land attack weapons will include the Tomahawk cruise missiles (Blocks II, III and Tactical), the supersonic LASM, and the upgraded 5-inch/62-caliber gun using both



FC2 Markowski, FC3 Hirleman, FC2 Kermon and FC3 Tayaba man the Firing Officer's Console aboard USS ***John C. Stennis*** (CVN 74). *(PH2 Rick L. Soileaux/USN)*

conventional munitions and ERGM. Although both ERGM and the LASM are 'fire and forget' weapons, the ship will monitor and control the Tactical Tomahawk cruise missiles in-flight by a two-way satellite communications link. Tactical Tomahawks will have the capability to 'loiter' in an area and receive new targeting information to engage emerging and time-critical targets.

Land attack weapon support systems will include: **(1)** The Naval Fires Control System (NFCS) that will provide platform level mission planning and coordination for all assigned land attack assets and weapons, **(2)**The Mk 34 Mod 1 Gun Weapon System that will perform engagement planning for, and execution of, both conventional munition and ERGM missions, **(3)** The LASM Fire Control System that will perform engagement planning for, and execution of, LASM missions, and, **(4)**The Tactical Tomahawk Weapon Control System (TTWCS) that will perform engagement planning for, and execution of, Tomahawk missions. In addition TTWCS will perform the overland engagement planning and control for the Tactical Tomahawk missions and the GPS guided Block III Tomahawk missions.

Additional land attack support systems include: **(1)** The Combat Information Center to provide command and control over the ship's multiwarfare assets, **(2)**The Navigation Sensor System Interface (NAVSSI) to provide GPS satellite information to the weapons before launch, **(3)** The Inertial Navigation System (INS) to provide ship's navigation information to the weapons before launch, **(4)** The AN/SPY-1 radar to provide threat projectile tracking information for counterbattery/counterfire calculations, as well as to provide friendly projectile and missile tracking information for deconfliction and identification purposes, **(5)** The VTUAV Tactical Control System to plan the VTUAV missions, and to control the air vehicle and payload, **(6)** The Precision Targeting Workstation (or similar functionality) to extract precision targeting coordinates from received imagery, and, **(7)** The Vertical Launch System to launch both LASM and Tomahawk.

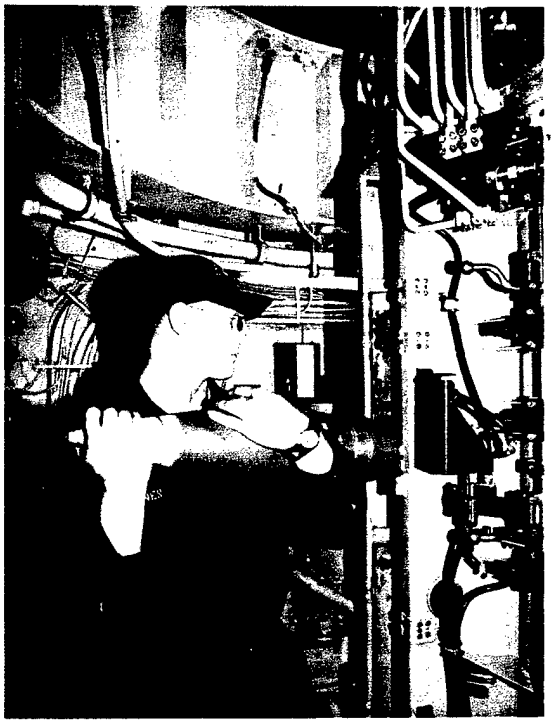
Common Land Attack Tactical Picture

The Commanding Officer/Tactical Action Officer and all Combat Information Center watchstanders must share a common land attack tactical picture across naval units as well as joint force units ashore and in the air. In the past, multiple command and control systems have been developed to provide separate air, surface, and subsurface tactical pictures. Divergence of these systems has led to a disjointed tactical picture across joint units. Therefore, one system aboard the combatant must be responsible for developing and maintaining the land attack tactical picture that will be common across the combat system at the command, coordinator and supervisor/operator levels. The platform level tactical picture will leverage the common operational/tactical pictures available through the Global Command and Control System - Maritime's DII COE architecture.

Combat Information Center (CIC) Organization

The existing CIC organization will evolve to accommodate the additional operator functionality imposed by the introduction of new land attack warfare capabilities. Currently the land attack mission areas of conventional Naval Surface Fire Support and Tomahawk strategic attack are supported within CIC. However, these missions are manpower intensive and are conducted by different groups of operators and support personnel (phone talkers, status board keepers, etc). The addition of significant new land attack operator functionality (e.g., information management, tactical picture management, VTUAV control, target acquisition, mission planning and coordination of other land attack units) highlights the need to develop a

GM3 Christopher King loads a 5-inch/54-caliber projectile in Mount 52 on board USS ***David R. Ray*** (DD 971). *(JOC Lance Johnson)*



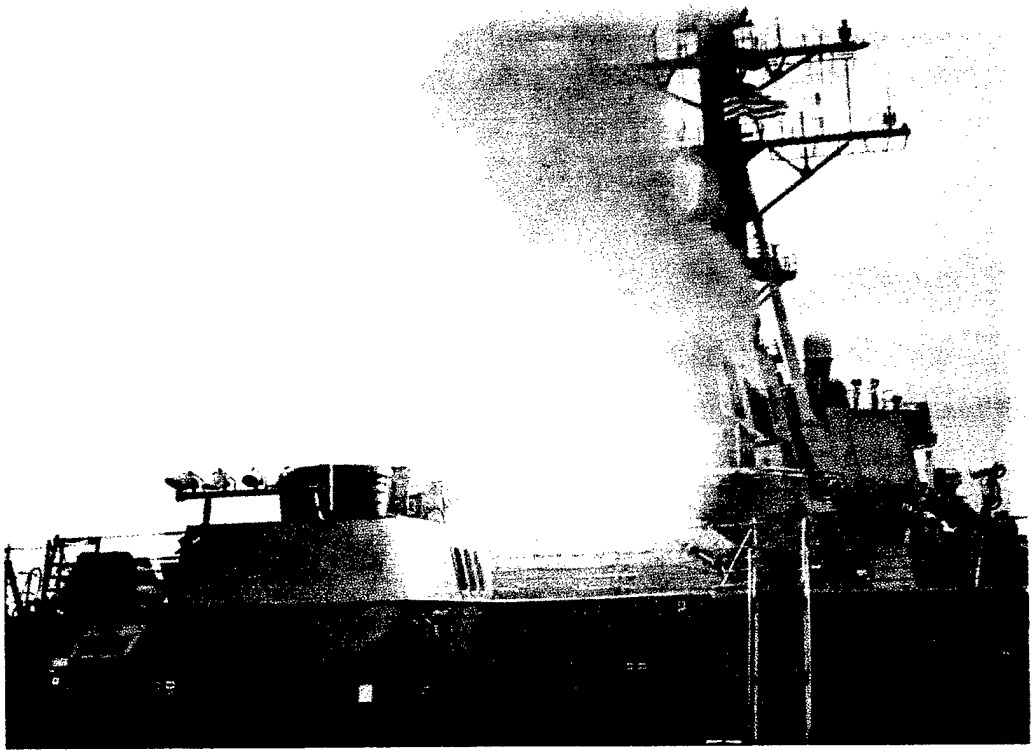
unified land attack CIC organization. This organization will be capable of simultaneously planning, targeting and executing multiple fire missions using all available weapons and resources with no increase in manpower requirements.

Multi-Warfare Operations

The CIC organization is designed to function effectively across several warfare areas at the same time. However, this requirement will be severely stressed when the ship operates close to shore where significant air, surface, subsurface and land-based threats exist; and when combined with reduced warning times, land masking effects and clutter typical of littoral operational areas. The ship may be tasked to operate in this near-shore environment to extend the inland reach of weapons, to reduce weapon time of flight, or to use the SPY radar for counterfire missions.

Flexible Manning Structure

During low-intensity operations, when there is no requirement for conducting land attack planning or fire missions, a full land attack team will generally not be on watch. In order to respond to increasing operational activities, the concept of flexible manning will be used. In flexible or "flex manning", the ship's standard condition-based readiness organization is replaced with a more streamlined organization that starts with a "core watch" for routine operations and then draws from a support matrix to provide or "flex" additional watchstanders in narrower mission-specific areas determined by operational requirements. All flex watchstanders will require certification across several mission areas and weapon systems. These additional watchstander responsibilities will be eased by the automation of functions and the use of standardized displays and procedures.



▲ A Tomahawk cruise missile is launched from USS ***Gonzales*** (DDG 66). *(PH1 Richard Rosser/USN)*

For land attack, the core watch would require a watchstander to maintain the tactical picture and provide an initial capability to conduct limited fire missions. Additional manning would be flexed from a support matrix as the complexity and task loading of the operational situation increases. Once the joint fires missions are completed, the added watchstanders would be flexed out of the matrix for resuming sustained combat operations. As a goal, during low intensity peacetime steaming, one supervisor will oversee all land attack operations.

This dynamic restructuring of operators is supported by general-purpose consoles. Any console can be used by any CIC watchstander, regardless of the warfare area assignment, to best address the immediate tactical needs. To maintain this flexibility while minimizing the number of consoles required, "land attack" consoles must be functionally interchangeable with other consoles as required to fulfill mission needs.

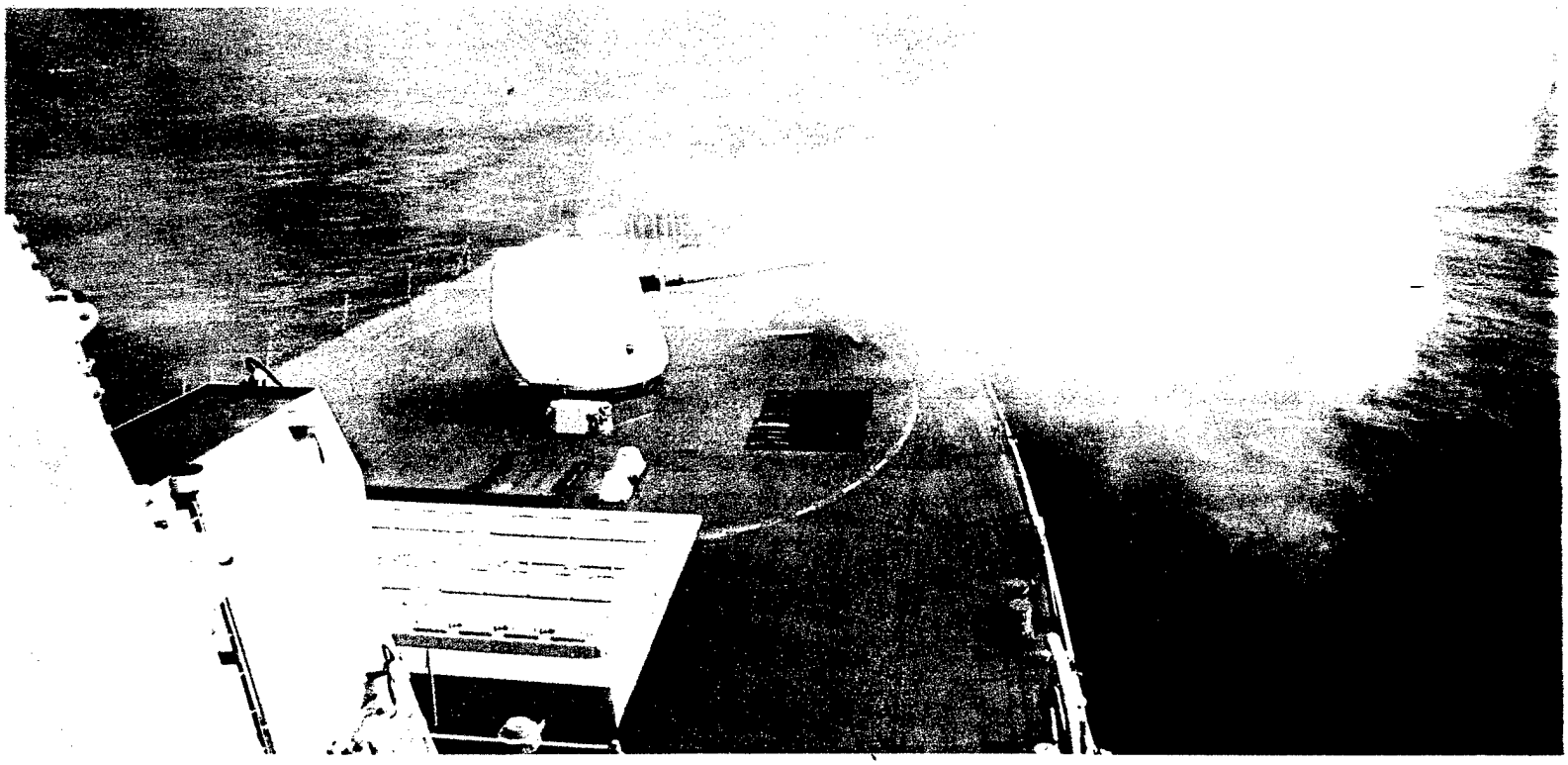
Land Attack Team

The land attack team will mirror the basic command, coordinator and operator structural organization followed by the other warfare areas in CIC today. Furthermore, all watchstanders will have immediate access to any appropriate tactical data and tasking activities, and watchstanders will have all appropriate controls to accomplish this access implemented at their consoles.

The command level watchstanders are the commanding officer (CO) and the tactical action officer (TAO) who exercise command level responsibility over all CIC operations. A land attack warfare coordinator (LAWC) will have responsibility for the land attack warfare mission area and will report to the CO/TAO. The LAWC will be responsible for maintaining a near real-time land attack capability as required when the ship is conducting other warfare missions. The LAWC, essentially the "land attack liaison officer", will assume the responsibilities of the former gun liaison officer.

For high intensity land attack operations, the LAWC will supervise several "flexed" operator level watchstanders who will execute the following four notional operating level functions:

>>>



- Information Management – Manage, receive and process organic and non-organic land attack information.
- Tactical Picture Management – Maintain the land attack tactical picture and provide appropriate situational assessments.
- Mission Planning and Targeting – Create and/or maintain fire mission plans and coordinate with organic and non-organic assets. Develop precision targeting data as required.
- Mission Execution – Conduct gun and missile fire missions.

Implementation

CLAWS was originally scheduled for full integration with the Aegis Combat System for Aegis Baseline 7 Phase 1 follow-on in 2005. However, with the cancellation of this Baseline, it is now unknown when this integration will actually occur. The CLAWS-Aegis integration remains a candidate for a future baseline upgrade and/or a backfit capability on designated DDG-51 and CG-47 Class ships.

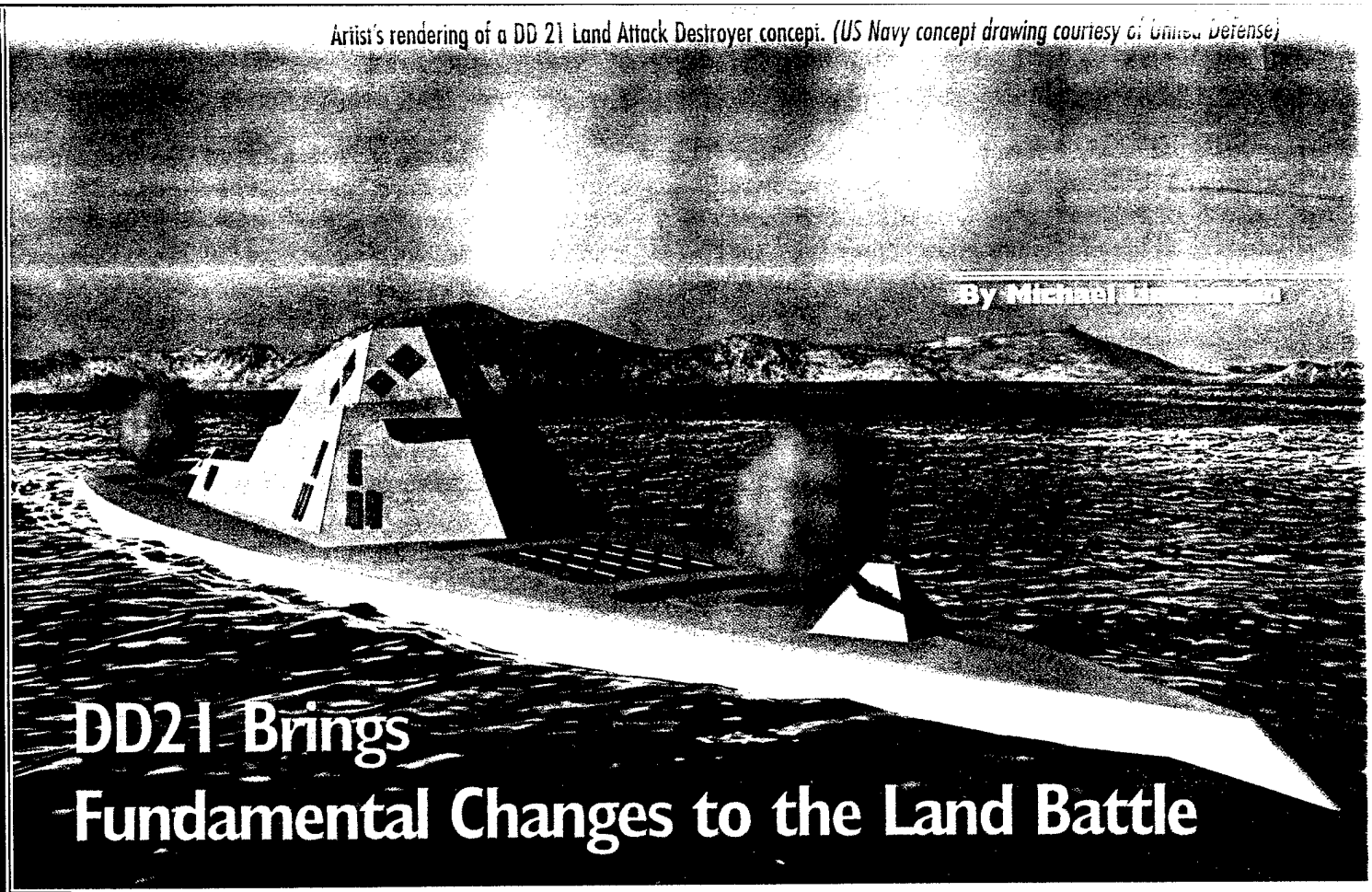
Regardless of the CLAWS – Aegis integration schedule, the creation of CLAWS from the various gun and missile control systems will continue. The following shows the tentative CLAWS implementation schedule by year:

- Today: Tomahawk Block II and III, Advanced Tomahawk Weapon Control System (ATWCS), 5-inch/54-caliber gun
- 2002: 5-inch/62 caliber gun
- 2003: Tactical Tomahawk, TTWCS, NFCS
- 2004: LASM; integration of NFCS, TTWCS, and the LASM FCS ■

Editor's Note: Mr. Weeks is the Aegis Land Attack Systems Engineer at NSWC Dahlgren, Code N13.

A 5-inch gun is fired from the deck of USS ***Carney*** (DDG 64). *(PH3 Anthiny Haley/USN)*

A Tomahawk cruise missile launches from USS ***Philippine Sea*** (CG 58). *(PH3 Renso Amariz/USN)*



Artist's rendering of a DD 21 Land Attack Destroyer concept. *(US Navy concept drawing courtesy of United Defense)*

DD21 Brings Fundamental Changes to the Land Battle

By Michael [illegible]

The Direction for Change

The United States and, in particular, the Department of Defense has been engaged in a continuing struggle to redefine the roles and missions of its services, and to maintain the force structure required to execute them. A principal outcome of this redefinition process is DD 21. This paper traces some key activities and events in that evolution.

Early Redirection

With the National Security Strategy of August 1991, the US moved toward a new focus:

"In the face of competing fiscal demands and a changing but still dangerous world, we have developed a new defense strategy that provides the conceptual framework for our future forces. This new strategy will guide our deliberate reductions to no more than the forces we need to defend our interests and meet our global responsibilities. It will also guide our restructuring so that our remaining forces are appropriate to the challenges of a new era. The four fundamental demands of a new era are already clear: to ensure strategic deterrence, to exercise forward presence in key areas, to respond effectively to crises and to retain the national capacity to reconstitute forces should this ever be needed."

And a smaller force:

"Our future military will be smaller. Assuming there are no unforeseen, worrisome trends in the security environment, by mid-decade our force can be some 25 percent smaller than the force we maintained in the last days of the Cold War. The changes we have seen in the overall international environment have made this smaller force possible, and the increasing demands on our resources to preserve the other elements of our national strength have made it necessary."

The first navy direction came in October 1992 with the release of ...*From the Sea,* co-authored by Secretary Sean O'Keefe, ADM Frank Kelso, Chief of Naval Operations, and General Mundy, Commandant of the Marine Corps. The term "Littorals" was introduced as a new focus for the naval service.

"Our strategy has shifted from a focus on a global threat to a focus on regional challenges and opportunities."

"Operating forward means operating in the littoral or "near land" areas of the world."

"Power projection from the sea means bombs, missiles, shells, bullets, and bayonets. When Marines go ashore, naval aviation aboard aircraft carriers and, if required, land based expeditionary aircraft will provide them sustained, high-volume tactical air support ashore to extend the landward reach of our littoral operations."

Joint Mission Area Assessments, first conducted during September 1992 through February 1993 under the direction of VADM W.A. Owens (OPNAV N8), and the leadership of R.C. Allen (OPNAV N81) had as its objective to prioritize all Navy program elements in accordance with the new strategy and in a joint context. One of the six JMAs was the Joint Littoral Warfare Assessment. The final recommendations of this assessment, led by RADM Phil Quast (OPNAV N86) and MGEN Harry Jenkins (OPNAV N85) included the following core of a very constrained investment strategy:

"A high quality force must be tailored for Littoral Warfare, to maintain battlespace dominance, to conduct power projection, with joint connectivity. ... The driving principal was to retain and invest in capable ships, while retiring those with limited capability at the earliest convenience."

Details of the strategy included a 326 ship force consisting of 116 surface combatants plus 16 active reserve FFGs and 12 aircraft carriers. The new-start power projection program recommendation contained only an Armed Helicopter.

The *Bottom-Up Review* of 1992, signed by Secretary of Defense Les Aspin, introduced the concept of force structure based on a two Major Theater War requirement. The report gave the Navy the following direction "in order to support the defense strategy and provide the capabilities needed to win major regional conflicts quickly and decisively:"

"While cutting significantly the forces devoted to "blue water sea control, the navy is undertaking improvements and innovations in naval air and amphibious lift that will enhance its ability to bring power to bear in a land battle."

Through these early months, the surface Navy's contribution to power projection and support of the land battle was limited to the very effective and Gulf War proven Tomahawk and the anticipated new Area TBMD missile, SM2 Blk IV-A. The thirteen nautical mile range of the 5-inch guns did not satisfy power projection needs. In a broader sense of supporting the land battle, the surface combatant as an enabler, provided protection to the aircraft carrier, to the amphibious ships, and to arriving sealift ships.

Evolution of the DD21 Concept

The initial investigations into the potential value of a new land battle oriented surface combatant came in 1994 and 1995. Previous to that time, the OPNAV Surface Warfare staff was concentrating on executing the CG-47 and DDG-51 acquisition strategy.

Large Capacity Missile Ship

One study that developed a specific force acquisition strategy for OPNAV N86, sponsored by RADM Tom Marfiak (OPNAV N863)

was the *Twenty-First Century Surface Combatant Force Architecture Study.* This study, conducted during FY95, investigated mission level requirements across the peace-time-wartime spectrum, assessing force acquisition options to sustain force structure in a limited budget environment. The recommended investment option included a six ship Large Capacity Missile Ship class each featuring a 512 cell VLS, designed to be forward deployed to satisfy the continuing deterrence need for in-theater Tomahawks and to alleviate the shortfall of early capability in-theater at the start of a major conflict. The land battle missions included strike and interdiction of invading armor. An armor defeating submunition warhead (Brilliant Anti-Tank submunition) was envisioned for Tomahawk, based on a contemporary Center for Naval Analyses study. The study also recommended that a second combatant class, the Sea Dominance Combatant, be constructed concurrently with the Large Capacity Missile Ship. It sustained force structure at the 130 level and remedied the shortfall in mission capability caused by the retirement of DD963s and FFGs

Maritime Fire Support Ship

In February 1995, Mr. John Douglas, Assistant Secretary of the Navy (Research, Development and Acquisition) initiated a Cost and Operational Effectiveness Analysis (COEA) effort to recommend a design for the 21st Century Surface Combatant (SC-21). The COEA was under the direction of RADM Phil Coady (OPNAV N86) and Mr. Ron Kiss, Deputy Assistant Secretary of the Navy (Ships). The tasker required the COEA team to identify mission deficiencies, estimate the requirement for the naval surface forces, and to evaluate the costs and benefits of reasonable alternative designs for the new surface combatant. RADM Dan Murphy (OPNAV N86) presided over the final year of the COEA and injected a strong influence in favor of a full land battle mission for the new combatant along with increased attention to acquisition and operating cost containment. The two-year study reported out in June 1997. It recommended a new Maritime Fire Support Ship concept whose missions included strike and long range precision fire support, and whose hull would be common with a follow-on CG 21. Features included 128 to 256 VLS cells, a new 155mm gun with a 1200 round magazine, a helo and UAV hanger, and a very capable ASW combat system. This ship extended land battle missions beyond strike and interdiction to include fire support for the Army as well as for the Marine Corps. This multi-mission combatant obviated the need to build a concurrent surface combatant.

◀ Navy SEAL team personnel conduct special warfare insertion techniques. (*PHC Ted Salois/USN*)

Arsenal Ship

The Navy and DARPA entered into an agreement in March 1996 to produce a demonstrator ship for a new class surface combatant that was based on the Large Capacity Missile Ship and the evolving Maritime Fire Support Ship. The ship concept also included a launch capability for air dominance and TBM defense missiles. It was envisioned to have a very small crew (50) and would ultimately, in its operational configuration, feature 500 VLS cells that could fire Tomahawks, ATACMs, SLAMs and SM-2s, as well as contain a large caliber long range gun. The program operated under very tight cost goals, which caused it to employ innovative acquisition techniques that bypassed much of the normal DoD acquisition process. The program was terminated in October 1997 due to inadequate funding in FY98.

The DD21 Program

The Under Secretary of Defense for Acquisition and Technology signed the Acquisition Decision Memorandum in January 1998 based on the SC-21 COEA results. The direction was to implement the COEA concept and include design and acquisition features of the Arsenal Ship program. The DD21 Program was thus formally established. It has since been reorganized to become the PEO (Surface Strike).

The PEO(S) has also undertaken the development and acquisition of two key weapons to provide DD21 with a true support the land battle mission. They are the Advanced Gun System (AGS) and the Land Attack Missile (LAM). Together, and with Tactical Tomahawk (TACTOM), they give the DD 21 unprecedented capability in weapon range, ordnance accuracy, and magazine capacity. Each is essential in providing meaningful joint theater level capability.

The Advanced Gun System will be a 155mm gun and is expected to increase today's surface navy's gun reach nearly ten fold with it's 100 nm range. It will fire the ERGM (Extended Range Guided Munition) round to achieve these ranges along with the necessary accuracy. Both unitary and submunition warheads are being considered. Of particular note is the anti-armor round that carries two SADARM submunitions. The DD 21 has two barrels and a magazine of 1200 to 1500 rounds. These rounds will be capable of being underway replenished. Together, the characteristics of this gun make it a most significant factor in the new land battle mission.

The Land Attack Missile has yet to be defined, but its operational characteristics have been determined. It is expected to be a 250 nm supersonic missile with a family of warheads including anti-materiel and anti-armor

submunitions, brilliant antitank weapon (BAT), and penetrators. It will fill the gap between the advanced gun system and the more capable, and expensive, Tactical Tomahawk. Filling this 150 nm gap is an important capability as the Marine Corps' V-22 becomes operational in numbers.

The DD21 in Operation

The six years of refocus and refinement of surface navy missions and resulting accommodation of budgetary constraints is producing a truly formidable new surface combatant with fundamentally new mission capability, bringing with it opportunity for new operational mission tasking.

The land attack mission can be categorized into three different tasks: Strategic Attack or Strike, Interdiction of the Invading Armor, and Fire Support. Each of these three present different targeting and kill challenges. The new DD21 will be uniquely able to excel in each, with a combination of weapon reach, firepower and magazine capacity.

Strategic Attack/Strike

Strategic attack is defined here to be strikes intended to damage or destroy the enemy's strategic capacity to make war. These targets are typically deep in the enemy's territory and heavily defended. The desired characteristics for a strike weapon are precision, stand-off, and a choice of warheads (unitary blast, submunition, penetrator, and special purpose). For the surface combatant, strategic attack has been, and will continue to be, Tomahawk: TLAM today and Tactical Tomahawk in the future. With operational ranges of up to 1500 nm, accuracies measured in meters and a family of warhead options, Tactical Tomahawk will be the Joint Commander's weapon of choice. Although all surface combatants of the 2015 timeframe will carry Tomahawk, a single DD 21 in theater, with its 128 to 256 VLS cells devoted to land attack, will substantially increase the number of available Tomahawks forward deployed in any given theater.

Interdiction of Invading Armor

It is always desirable to engage and destroy enemy armor before it reaches friendly troops. The challenge has been to find and target them while well behind enemy lines, and to deliver weapons while the surveillance information is fresh. It cannot be adequately handled in the normal air task order cycle. Also, moving armor in a major theater war can provide a target rich environment where a concentrated attack is required to achieve a significant fraction of kills. Key ingredients to a successful mission are timeliness, targeting, accuracy, and armor killing warheads.

When combined with the theater-level targeting promise of network centric warfare and the long reach of DD21 weapon systems, new warhead developments make it possible to remotely launch weapons that can quickly find and kill armor vehicles on the move. Of particular note are the Brilliant Anti-Tank (BAT) weapon and SADARM, each using different techniques for detection, guidance, and kill. BAT is being considered as a warhead for Tactical Tomahawk and the Land Attack Missile, while SADARM is being considered as a warhead submunition for the Advanced Gun System round. When these systems are delivered with the first DD21, enemy armor vehicles will travel with great risk, and the surface navy will field a fundamentally new capability.

Fire Support — U.S. Marine Corps Amphibious Operations

The guns of the surface navy have historically been the principal providers of beach preparation and close fire support for amphibious operations and, to some extent, for the army for forces close to shore. The surface combatant fire support requirements are based on Marine

Corps requirements. With the new operational concepts being developed by the Marine Corps and corresponding new systems as AAAV and V-22, a better articulation of supporting fires requirements has been documented.

Gen. Paul Van Riper signed a letter in December 1996, *Naval Surface Fire Support Requirements for Operational Maneuver from the Sea.* In it he specified a range objective of 63 nm to counter inshore enemy fires being directed at the beach, and a 325 foot accuracy at range. This range requirement would increase to 200 nm to protect V-22 landing sites as that aircraft becomes available in numbers around 2010. He further stated that each fire support ship should provide the firepower of at least a 155mm artillery battery.

In his 1999 letter, *Naval Surface Fire Support Requirements for Operational Maneuver from the Sea – 1999*, Gen. Rhodes explained, refined and updated the earlier requirements document. In it he specified a 65-foot accuracy for all ranges.

The operational intent is for the surface navy to provide the required fire support for a MEF sized operation during the first three days, until the Marines can bring their organic artillery ashore. This implies a naval surface fire surface support level of 12 battery equivalents.

Gun range and accuracy and ship firepower have been all been limiting factors for the surface navy in meeting this support requirement. Today's 5-inch guns have an approximate range of 13 nm with accuracies in the hundreds-of-feet—and a single 5-inch/54 cal. gun DDG 51 falls somewhat short of matching the battery equivalency. The new 5-inch/62 cal. guns with ERGM, reaching to 63 nm with accuracies to 30 feet overcome the range and accuracy limitation. It remains for DD 21 with its Advanced Gun System and Land Attack Missile to satisfy the longer term requirement. The surface navy will, for the first time, satisfy the standing Marine Corps fire support requirement.

Fire Support—Ground Forces

Although there is some recognition of the potential impact the DD21 can have on Army operations, the extent of its potential is only beginning to be appreciated. The SC 21 COEA based much of its recommendation on the analysis results that indicated the Maritime Fire Support Ship can have a measurable positive influence on the land battle, in terms of fewer US casualties, less enemy advance, and fewer days to end the war. The analysis did not examine specific operational concepts.

◀ Members of SEAL Team Two conduct SEAL Delivery Vehicle (SDV) training. *(PH1 Andy McKaskle/USN)*

A recently completed study for OPNAV N86, the *Twenty-First Century Surface Combatant Force Level Study (SCFLS II)*, examined DD 21's fire support to ground forces potential in greater detail. The study examined the coverage (land area reached), the firepower (rate of targets killed) and capacity (number of targets killed per magazine). A parametric analysis of DD 21 fire support capability with its advanced gun and land attack missile showed a dramatic improvement in the surface navy's ability to support a land battle. The study also examined DD 21 capability in a major theater war campaign, proposing a specific concept of operations for DD 21 in support of the army and estimating the resulting ordnance used to provide that support. Informal discussions with members of the Army's Battle Lab at Ft. Sill, Okla., indicated an interest in DD 21 acting as a mobile fire base in support of the ground troops during the Build-Up Phase of the campaign. The concept allowed the Army to continue to stockpile its arriving ammunition for use later in the Counteroffensive Phase. The campaign scenario provided information sufficient to estimate enemy reinforcement and resupply activity. Other typical supporting fire tasking (counterfire, neutralization, JSEAD, and harassing fires) was included in the analysis. The result showed DD21 as a major contributor in this phase of the war. During this thirty-day period, the DD21 in-theater fleet would engage and defeat 2250 resupply, counterfire and neutralization targets and 3300 armored combat vehicles. DD21 would expend over 200,000 gun rounds and over 1300 land attack missiles against these assigned targets. A similar analysis of DD21 supporting an amphibious assault conducted in this campaign produced an expected ordnance usage of 12,000 gun rounds and 150 land attack missiles. Although these numbers seem large in comparison to short duration amphibious operations, they represent less than 20% of the Army 155mm DPICM available for the campaign.

A Fundamental Change

When the DD21 arrives on the scene in 2011, the surface navy will already have a change underway in its support of the land battle. Tactical Tomahawk, Land Attack Standard Missile, and the 5-inch/62 will have been operational for eight years. The reach of surface combatants will have significantly increased. But it is with the firepower and capacity of the DD21 that the surface navy will fully realize its potential in supporting the land battle.

About the Author

Mr. Michael J. Lindemann is a Principal Engineer at the Naval Surface Warfare Center, Dahlgren Division, (Code T505).

The Navy Distributed Engineering Plant

Another Link in Supporting the Fleet

by Jeff McConnel

INTRODUCTION

In the past decade, the fleet has seen a significant growth in tactical networking capabilities such as LINK-11, LINK-16 and Cooperative Engagement Capability (CEC). These capabilities are enabling battle groups consisting of many platforms including ships, submarines and aircraft to increasingly operate as a single warfighting system. At the same time, this level of integration of previously independent platforms has lead to interoperability problems within the battle group. Systems engineering discipline points to the need for a land-based battle group testbed as one tool to help address these interoperability issues while engineering and certifying emerging battle group capabilities. The Navy Distributed Engineering Plant (DEP) has been assembled to address the need for a shore-based test bed to aid in the development of integrated, interoperable Naval Battle Groups, as well as future Joint battleforces.

BACKGROUND

Interoperability

The rapid, accurate exchange and display of tactical and strategic data is the great force multiplier that enables our combat forces to operate as a single integrated fighting force. Interoperability is achieved when each ship and aircraft in the force can exchange tactical and strategic information smoothly, quickly, and reliably with every other platform in the force so that each platform has the same coherent tactical picture.

With the formation of the earliest naval flotillas, interoperability took the form of simple communications between ships. These communication methods generally consisted of semaphores, lanterns and other signaling devices in the hands of human operators. They were restricted by environmental factors such as fog, darkness and line-of-sight, procedural problems such as message formats and definitions as well as general training and interpretation issues. The advent of radio in the early 20th century overcame many of the environmental problems of previous methods, introduced several new environmental problems and is still subject to many of the classic procedural and training interoperability issues.

In the mid-20th century computer systems began to appear on board ships and took on increasingly important functionality in support of shipboard missions. Over time various computer systems were linked to each other within a ship and finally computers on different ships linked to each other as well as to airborne, submarine and shore-based platforms. Today, inter-computer connectivity between ships or any group of platforms has become mission-critical and various interoperability issues that can impact the mission of the platform and the battle group have accompanied each expansion in connectivity.

Even early attempts to connect computer systems within a ship experienced interoperability problems. These problems were often caused by procedural and training deficiencies, with interface specification and interpretation as a key contributor. These problems have been overcome or mitigated by implementing systems engineering discipline, accompanied by rigorous intra-platform integration and testing. Today these disciplines are usually supported by several dozen stand-alone land-based combat systems that faithfully replicate the computer hardware, computer program and support equipment configuration of the ship combat system. These stand-alone facilities enable development, integration and validation of complex systems within a controlled, repeatable environment.

Interoperability between ships and other units of a naval battle group has often fallen outside of the scope or budget of any one program or agency. As this battle group-level interoperability has become critical to the mission of the battle group the need to apply systems engineering and systems development practices to the entire battle group has become apparent. The need for a shore-based battle group testbed, as a tool for battle group systems integration and testing, has become critical.

DEP CONCEPT DEVELOPMENT

In February 1998, the fleet reported concerns regarding interoperability failures among combat systems recently installed in deploying Fleet units – resulting in two modern combatants tied to the pier during their battle group deployment. A great deal of fleet time during the final six months prior to battle group deployment was being consumed with shipboard and battle group "debugging" of systems at the expense of valuable fleet training time.

In March 1998, the Chief of Naval Operations assigned to the Naval Sea Systems Command (NAVSEA) the responsibility to address combat systems interoperability problems across BMC4I/combat systems, and to coordinate resolution with the Fleet.

In April 1998, NAVSEA formed the Task Force on Combat System Interoperability to study the interoperability crisis and provide recommendations for solutions. In May 1998, the Task Force was formally tasked to determine the feasibility and cost of using a land based distributed engineering plant to support design, development, test, and evaluation of interoperability of battle force systems.

In June 1998, the Task Force on Combat System Interoperability reported that the establishment of a Distributed Engineering Plant (DEP) was technically feasible, but orga-

Figure 1: The Navy Alliance

Naval Surface Warfare Center/DD - Dahlgren, VA
Aegis Combat Systems Center - Wallops Island, VA
Naval Warfare Analysis Station - Corona, CA
Naval Undersea Warfare Center - Newport, RI
Naval Surface Warfare Center/PHD - Oxnard, CA
SPAWAR Systems Center - San Diego, CA
Naval Surface Warfare Center/PHD - Dam Neck, VA
SPAWAR Systems Center - Charleston, SC
Naval Surface Warfare Center/PHD - San Diego, CA
Aegis Training and Readiness Center - Dahlgren, VA
Naval Research Laboratory - Arlington, VA
JHU Applied Physics Laboratory - Laurel, MD
Naval Air Warfare Center/AD - Patuxent River, MD
Naval Air Warfare Center/WD - China Lake, CA

nizationally difficult because of the diverse group of organizations and elements involved. The Task Force also emphasized that a Distributed Engineering Plant is only a tool to enable good design decisions earlier in the acquisition process.

Following the Task Force Report "Error! Reference source not found" the collection of government activities formed a cooperative effort known as the Navy Alliance. The Navy Alliance made up of surface, air, subsurface, and C4ISR components crosses all Navy Systems Commands (SYSCOMS). The initial purpose of the Navy Alliance was to develop a proposal for the establishment and implementation of a Navy DEP. The DEP concept, as drafted by the Task Force and developed and engineered by the Navy Alliance is described in the following sections.

DEP CONCEPT OVERVIEW

Combat Systems: The DEP Foundation

The DEP is founded on the existence of the shore-based combat system sites mentioned earlier in this text. These combat system sites have been built to replicate the hardware, computer programs, connectivity and environment of the ship and aircraft combat systems to the maximum extent possible. The DEP basically extends this concept to the battle group level by interconnecting these combat system sites in order to replicate a battle group.

Given that the DEP is founded on shore-based combat systems, understanding the DEP begins with an understanding of a basic combat system. The combat system consists of many key elements tightly integrated to form a system. For the purposes of this discussion, the core combat system is made up of a few main functional groups.

A sensor suite consisting of transmit and/or receive devices plus computers controls the sensor and process data. These systems search well beyond the range of human senses in many environments and many spectra using passive and active means to detect friend and foe alike. A weapons suite consisting of weapons, launchers and weapons control computers manage scheduling, coordination and launch processing.

Central to the combat system are computer systems to perform Command and Decision (C&D) processing including databases, decision aids and tactical Man-Machine Interfaces (MMI). These systems take the input from various sensors and apply various filters, rules and associations to the data to give the human operators the most complete and accurate information for situational awareness and decision-making.

And finally, tactical communications systems consisting of processing and control computers plus the associated transmit and/or receive devices enable the sharing of commands, data and information between the combat system and local and remote systems. At many levels, sensor data as perceived by the combat system elements is shared over these systems.

The four key functional groups of combat systems elements described to this point are for the most part common to all combat systems onboard all combatants in the air, surface and subsurface Navy as well as the combatants of any Service. The mix of systems and subsystems within a functional group varies widely between combatant types depending on the mission of the combatant.

Shore-based combat system development, integration and test facilities generally replicate all of the hardware and computer programs represented by the large blue box in "Error!

Figure 2: Combat System Functional Groups

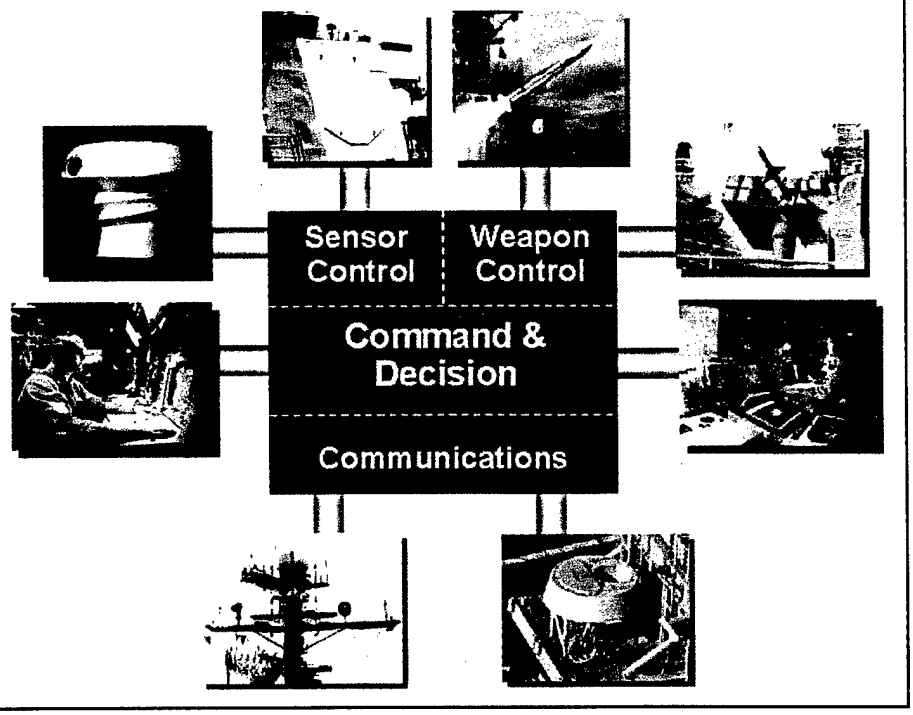
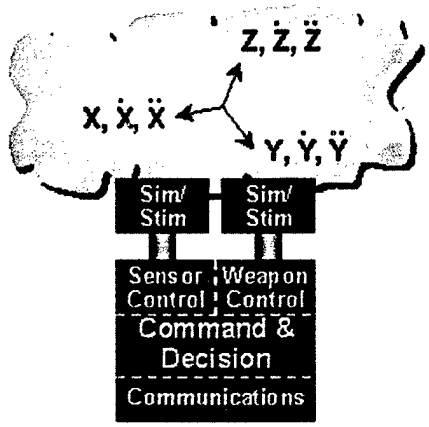


Figure 3:
Combat System Sim/Stim



Reference source not found." Wide variations in the scope of this replication do exist at the interfaces of the box. For example, some sites do include a live radar that radiates to the atmosphere or that is stimulated by radio frequency horns. Other sites have actual weapon launcher equipment and inert operational missiles.

Any weapon, sensor or system not available to a shore-based combat system is emulated via a simulation or a stimulator (sim/stim). In addition, the sensor and weapon sims/stims generate a common environment representing the real world and entities within it. For Air Warfare this virtual world comprises at least the 3-D atmosphere while entities can include ships, aircraft, missiles, satellites, clouds, etc. Entities possess many of the attributes of a real world object such as position, velocity, size, radar cross-section, IR emissivity, vulnerability, etc. In this manner, a shore-based combat systems' simulated sensor can detect an entity (such as a threat aircraft), command and decision elements decide to engage the threat, the weapons suite launches a simulated weapon against the threat and the simulated sensor will detect the intercept. The entire sequence is performed within a controlled, repeatable environment under the close scrutiny of engineers and developers.

By assembling real hardware-in-the-loop elements along with their associated computer programs and by emulating the world external to this assembly with appropriate fidelity sim/stim, a majority of a combat systems' functions can be fully exercised ashore. For instance, an operator sitting at a console of a shore-based combat system will see the same tactical display and information as an operator at sea. In many cases, certain functionality can only be fully exercised ashore. For example, subjecting a combat system to a mass raid of hundreds of simultaneous, diverse, inbound threats can only be performed in a shore-based environment. In this manner, the ability of the combat system to handle the same type of battle can be fully tested and quantified before the ship is put in harms' way.

DEP CONCEPT OVERVIEW

Pulling the Pieces Together

The DEP facilitates the federation of many of these shore-based combat systems across country in the following manner: First, candidate shore-based combat systems are identified and cataloged along with their basic capability, configuration and associated sim/stim capability. In "Error! Reference source not found" these combat systems and their sim/stim are represented by the boxes in the middle layer. Blue boxes such as AEGIS and Advanced Combat Direction System (ACDS) represent systems currently in the DEP. Purple boxes such as Ship Self Defense System (SSDS) and Common Command & Decision (CC&D), represent systems that will join the DEP in the future.

A Common Environment represented by the blue cloud is created and shared by all combat systems. This environment is created using Distributed Interactive Simulation (DIS) Protocol Data Units (PDUs) that describe all the attributes of an entity. The common environment is shared by passing all PDUs over a high-speed network available to all combat systems. DIS compliant sims/stims at all sites monitor all PDUs and determine how and when the combat system elements will interact with the PDUs.

Standard Tactical Communications (e.g., LINK-11, LINK-16, CEC) are shared between combat systems and other systems via a high-speed network represented by the brown cloud. This element is built to emulate many communication types including broadcast, point-to-point, network (Internet Protocol), etc.

As represented by the green cloud, each site is linked via a data extraction network for collection and sharing of extracted tactical and ground truth data as well as a collaborative engineering network that provides real-time video, voice and other formats that enable the sharing of engineering and support data.

Finally, data analysis tools represented by the red box allow the rapid comparison of perceived data out of the combat systems to ground truth from the common environment. This ability along with bit-by-bit data analysis and GPS time-tagging at all sites enables rapid isolation of faults.

Figure 4: Assembling the DEP Architecture

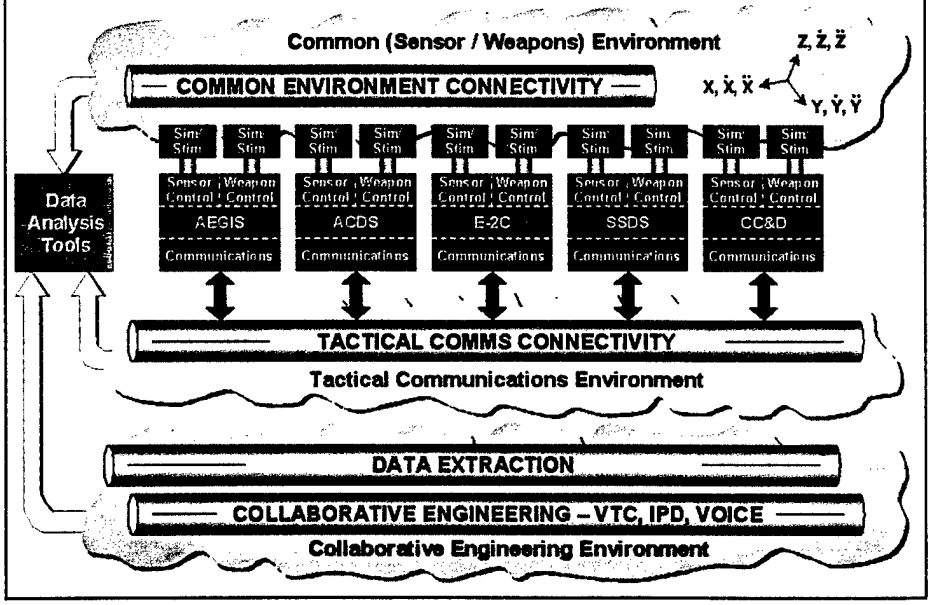


Figure 5:
The DEP ATM Network

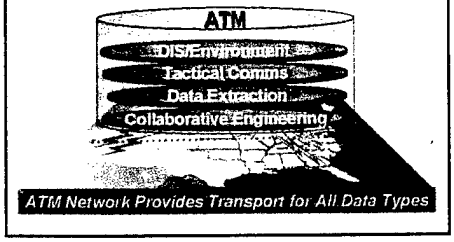
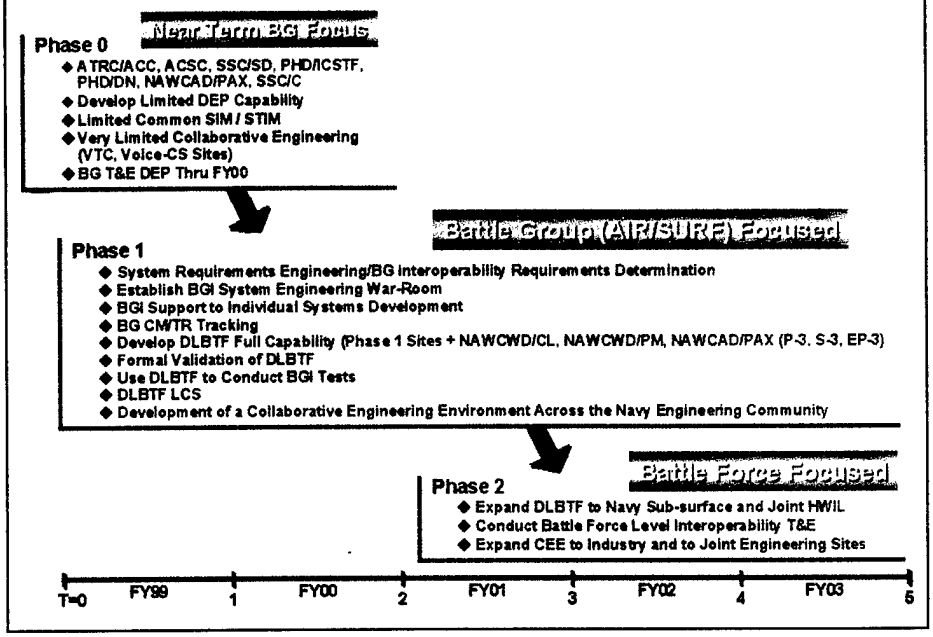


Figure 6: The Navy Alliance Proposal



DEP ESTABLISHMENT

On September 8, 1998 the Navy Alliance proposed a three-phase approach to the Battle Force Interoperability Flag Steering Group. The Flag Steering Group directed the Navy Alliance to execute Phase Zero of the proposal with an objective to have the DEP ready to test and certify the ***Kennedy*** Battle Group in January 1999, six to seven months prior to deployment.

Over the course of a four-month period, the Navy DEP concept was transformed into reality and assembled into the ***Kennedy*** Battle Group configuration. In addition, the Navy Alliance formed an Interoperability Test working group with responsibility for the development and execution of interoperability test plans, scenarios and procedures for the Kennedy testing.

In January 1999, the Navy's first Battle Group Interoperability Test (BGIT) was executed for the ***John F. Kennedy*** Battle Group. Performance of the DEP was as good as or better than expected in all respects including replication of many fleet problems commonly encountered at sea. The "LINK traffic vs. ground truth" display in Error! Reference source not found. is just one example of problems replicated (in this case a dual-track situation with ground-truth in blue and LINK data in orange) during DEP test execution. For the first time, the operators were able to see the truth data and tactical LINK data overlaid on the same display.

DEP ACCOMPLISHMENTS

DEP has amassed a significant list of accomplishments from January 1999 to January 2000. In addition to the ***Kennedy*** Battle Group BGIT mentioned previously, the DEP has also executed BGITs for the ***Eisenhower***, ***George Washington***, ***Lincoln*** and ***Truman*** Battle Groups as depicted in the following illustration. A few of the products and general benefits derived from the DEP are described in the remainder of this section.

The primary product of the DEP is a characterization of the interoperability of the subject battle group. The first process supporting this characterization is anomaly discovery. For instance, any anomalies discovered during the ***Kennedy*** BGIT testing were immediately documented with Trouble Observation

Figure 7: The JFK Battlegroup Assembled Ashore

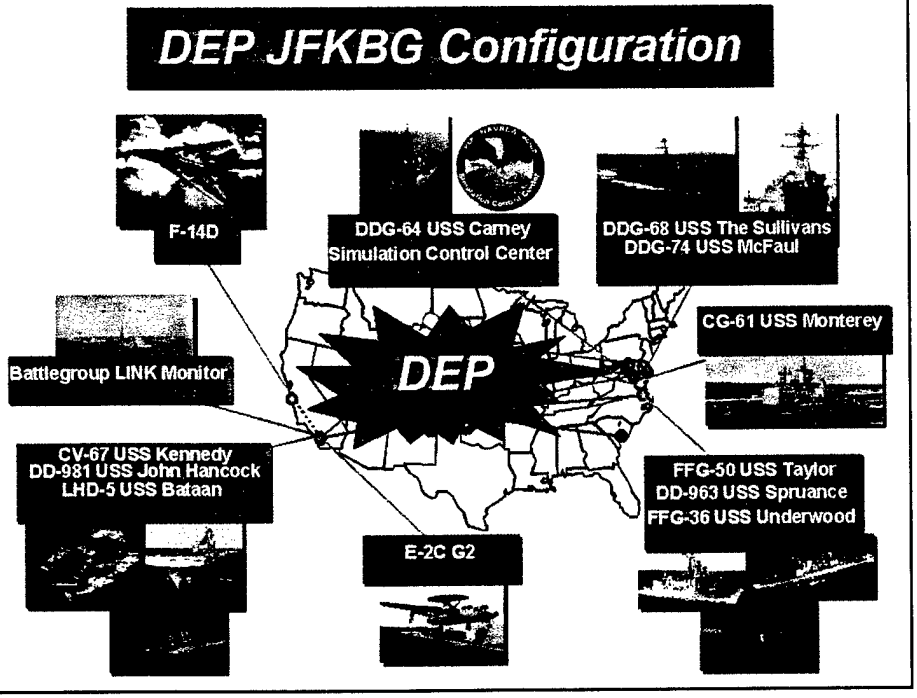


Figure 8:
LINK Tracks vs. Ground Truth

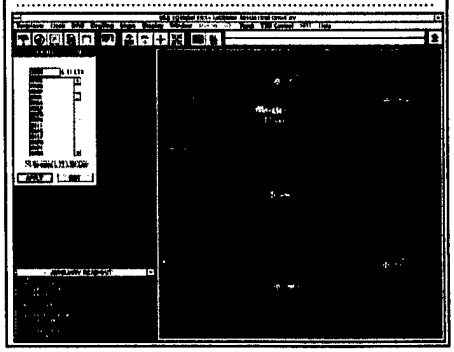
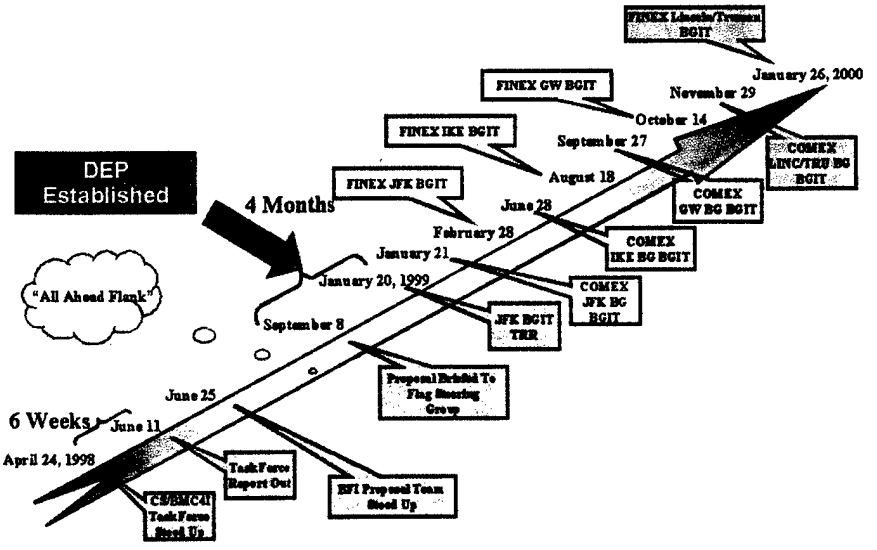


Figure 9: DEP Accomplishments



Reports (TORs) and forwarded with supporting sets of extracted data to the combat system Software Support Activity (SSA).

The problem resolution cycle was implemented to enable the rapid assignment and resolution of problems discovered. A key feature is the Data Collection and Management Committee (DCMC) consisting of experts from each of the systems under test during a BGIT. The experts within this committee rapidly analyze all TORs and convert valid problems into Trouble Reports (TRs) against the combat system element that had an anomaly. In addition, the BGIT Analysis Review Panel (BARP) depicted within the cycle is made up of platform SSA's, test engineers, program offices and fleet representatives from the subject battle group. One of the key attributes of this process is the involvement of the actual officers and operators from the deploying battle groups. The BARP provides the fleet with the means to establish the priority at which each problem discovered should be resolved by the responsible combat system program office.

Over the course of the execution of a BGIT, many pieces of evidence are collected that help to quantify the interoperability of a battle group. These take the form of the TORs, nightly situation reports, execution log books, and digital data recorded at each combat system, as well as the cumulative findings of the DCMC. Several weeks after BGIT execution and data analysis are completed, a BGIT Data Management and Analysis Report (DMAR) is generated for the battle group. This is a comprehensive document that captures the overall test objectives, test configuration, test execution details and test results for each BGIT.

Additional products and information are derived from or along with the DMAR. The first is a Capabilities and Limitations (Caps & Lims) document that is a formal method of reporting the capabilities of the Battle Group as well as limitations arising from known problems that cannot be fixed before deployment. Also, all TRs discovered during a BGIT are entered into appropriate combat system program office databases as well as the NAVSEA-53H master database. This ensures that anomalies will be tracked by cognizant program offices and fixed within the priority structure of the program office. Finally, lessons learned, scenario improvements and enhanced test procedures are utilized as a foundation for upcoming battle group BGITs.

THE FUTURE OF THE DEP

The BGIT Mission

As described in the previous sections, the main mission of the DEP since its inception has been the execution of a BGIT for each battle group that is preparing to deploy. This mission is accomplished by performing a shore-based integration of most of the combat system elements that comprise the deploying battle group, detecting as many problems as possible and characterizing the capabilities and limitations of the battle group as a whole. In order to increase the scope and fidelity of DEP replication of battle groups, the DEP has been continuously improved and expanded in its capability. The DEP will continue to add systems and subsystems in order to increase the percentage of battle group capabilities that can be replicated ashore.

Since the BGIT is now a required milestone for each deploying battle group, an aver-

Figure 10: BGIT Problem Discovery and Analysis Process

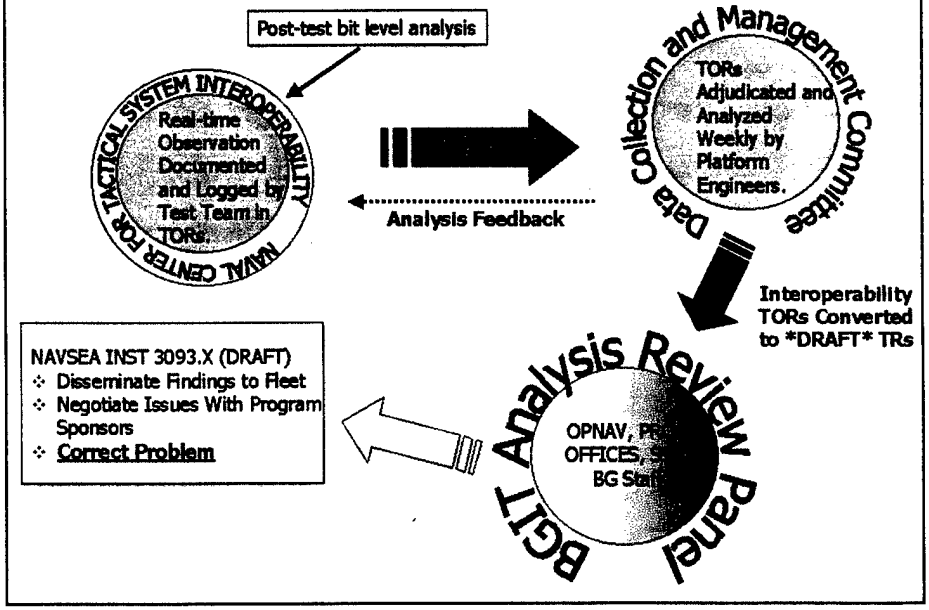
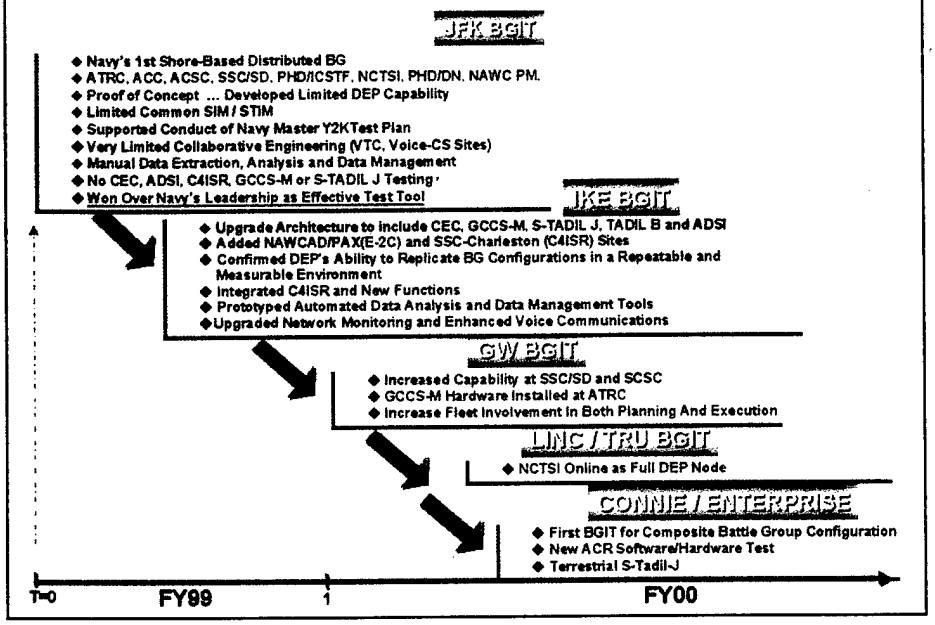


Figure 11: DEP Capability Growth



age of five to six BGITs are planned for each year into the foreseeable future. This new requirement is extremely challenging for the Navy personnel and resources resident at these land-based sites which still maintain the platform-level element testing, system testing and training. Of course, experience and efficiency has helped to reduce the total test hours required for each BGIT, but the real savings is believed to be witnessed through functional assessment of interoperability issues by similar systems rather than battle group specific compositions. This appears to be feasible if the battle groups are fairly similar in configuration and if their deployment dates are also relatively close. This could reduce the number of BGITs to four a year. The ***Lincoln/Truman*** BGIT was executed back-to-back, but was assessed as two separate battle groups. The first combined BGIT is being planned for the ***Constellation*** and ***Enterprise*** battle groups scheduled for testing later this year.

THE FUTURE OF THE DEP

New Missions for the DEP

To date, DEP has been focused on the end of the acquisition life cycle, i.e., T&E and certification. However, many other missions are envisioned. Planned missions are analogous to the various missions performed by individual shore-based combat system sites and includes battle group system level development, integration, testing, training and lifecycle maintenance.

The CEC program has already utilized the DEP to perform some aspects of CEC Independent Verification and Validation (IV&V) testing in preparation for CEC operational test and evaluation. A significant number of CEC requirements tests that previously required a live battle group as a testbed have recently been validated using the DEP. This in turn has reduced the burden of developmental testing that has previously been levied on the Fleet in lieu of training and other deployment activities.

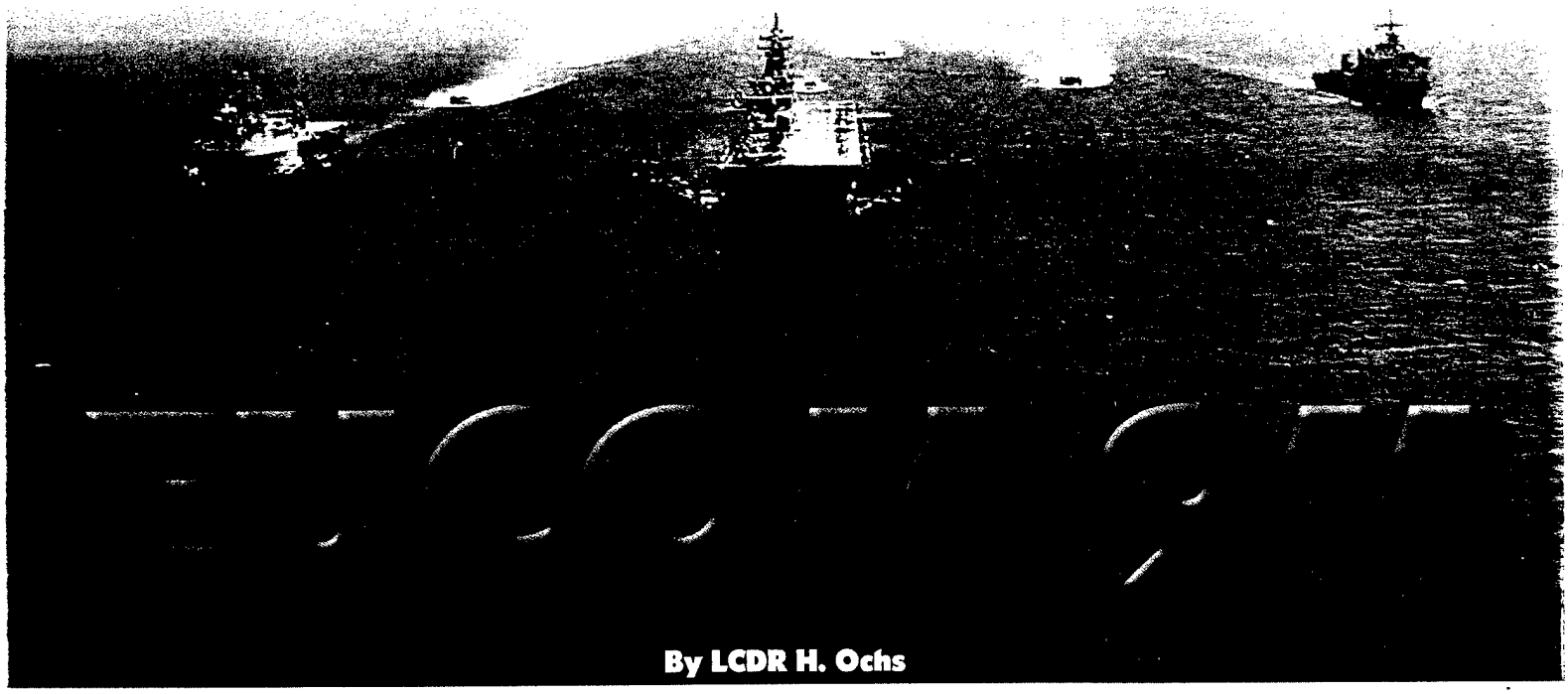
As the number of battle group-level capabilities (i.e. capabilities that require more than one combatant to execute such as CEC engage-on-remote sensor data) increase, the need for a shore-based battle group testbed such as the DEP will also increase. Meanwhile, the need to test and characterize battle group interoperability will continue into the foreseeable future as engineering solutions to the interoperability problem are developed within upcoming programs such as SSDS and CC&D. The DEP is currently working cooperatively with element and system level engineers to introduce multi-platform integration during the design and development phases of combat system assessment.

The Navy continues to advance the collaborative engineering aspects of the DEP. During the GW and Lincoln/Truman BGIT's the capability to transfer large classified data files was prototyped. Previously, the huge amount of data extracted during testing was captured to various types of magnetic media and then couriered to the analysis facility – often taking days or weeks depending on the location and format. The large bandwidth available through the classified ATM network, established on the DEP, allows the digital data to be directly downloaded to a file server and transferred immediately following the test. This capability will also serve the combat system developers. Similarly, the DEP provides a classified multi-point VTC and communications network for all sites.

CONCLUSION

Over the past few decades, the Navy has seen the word "system" applied to collections of larger and larger components. Today, the entire battle group is rapidly becoming a system that relies on the interoperability of individual platforms in order to achieve the missions of the battle group. In parallel the shore-based development and support community has provided the fleet with the best systems available by replicating these systems ashore to aid in development, integration and testing of these systems. The Navy DEP is yet another logical step in this long chain of support to the deployed fleet. Modern networking technology has made the establishment and initial success of the DEP possible for a relatively low investment in time and money. The DEP has made significant contributions toward resolving and quantifying interoperability issues in its relatively short lifetime and will continue to move this new capability back into the acquisition cycle, allowing interoperability to be *engineered in* versus testing for it just prior to deployment. ■

Editor's Note: Jeff McConnel is the Deputy Technical Coordinator at Commander, Naval Surface Warfare Center, Dahlgren.



By LCDR H. Ochs

Along the Northern Albanian coast line, an Army Apache helicopter lay blazing in ruins, its brave crew the tragic victims of a fatal night training mission accident. EUCOM 911 (European Command's Rapid Response Force – the Navy/ Marine Corps deployed Amphibious Ready Group (ARG)/Marine Expeditionary Unit (MEU)) had received an initial call for help on the Search and Rescue (SAR)/Combat Search and Rescue (CSAR) net. At 0300 aboard USS ***Kearsarge*** (LHD 3) in the crowded Adriatic waters, the leaders of Amphibious Ready Group Two and Two Six Marine Expeditionary Unit (Special Operations Capable) exchanged weary and knowing glances. There would be no TRAP (Tactical Recovery of Aircraft/ Personnel) mission tonight. The pilots and crew of the aircraft in standby felt both relief and fear as the news came down. Mission canceled. This one hit close to home.

Such was the start of a typical day for the Blue/Green Team in May of 1999, as the ***Kearsarge*** ARG, with its embarked MEU (SOC) and Naval Support Elements, stood guard off the coast of Albania in the Southern Adriatic Sea. Positioned within sight of land, the men and women of this highly trained group of professionals remained ready 24 hours a day to launch a recovery package for downed pilots up to 175 nautical miles inland within 60 to 180 minutes of notification. In addition to keeping constant guard for possible rescue missions, ***Kearsarge***'s flight deck launched AV-8B Harriers carrying live ordnance on Battlefield Air Interdiction (BAI) missions every day it remained underway in the Adriatic. These BAI missions contributed to Operation Allied Force, the Allied bombing campaign against Serbia.

In addition to the flag ship's contributions to the allied bombing campaign, USS ***Ponce*** (LPD 15) launched its embarked Pioneer Unmanned Aerial Vehicles (UAVs) on intelligence collection missions, which provided real-time imagery of enemy installations to both U.S. Forces and Allied pilots flying over enemy territory. Under the protective watch of the Sea Combat Commander, ***Ponce*** moved to the outer edge of the Coastal Defense Cruise Missile (CDCM) envelope, extending the range of its line of sight Pioneer UAV system to include enemy port facilities. In close coordination with the staff of the 6th Fleet Commander, these UAVs first flew over-water missions and then were subsequently tasked with an over land mission. Here they collected imagery of SAVA submarines and other enemy assets located in the ports of Tivat and Bar.

The entire ARG maintained a Maritime Intercept Operation (MIO) standby status and, although the capability was not employed, the ARG was ready to intercept foreign flagged vessels carrying materials designated contraband by the Allied Operation. The extensive hospital facilities in ***Kearsarge*** and the medical facilities in the smaller decks (USS ***Ponce*** and USS ***Gunston***

Hall (LSD 44)) remained in a mass-casualty standby status, capable of providing immediate relief to wounded service personnel, if necessary. EUCOM 911 had the watch.

While all this sounds like a full time job (and it was), the Blue/Green Team was charged with supporting a separate operation with a distinctly different charter. Operation Sustain Hope provided relief to the Kosovar refugees and Joint Task Force (JTF) Shining Hope, the US JTF for relief efforts in Albania, was tasked with the American component of this non-combatant mission, or "Operation Other Than War." In support of both operations, the same flight deck which launched bombing runs against Serbia would launch helicopters containing personnel and equipment dedicated to relief for Kosovar refugees fleeing genocide in their homeland.

The Blue/Green Team's contributions to the humanitarian efforts in Albania were primarily to provide security forces for both the refugees themselves, and the non-governmental organizations, channeling much needed supplies and building materials to the refugees. The MEU's Battalion Landing Team (BLT) provided approximately 300 security personnel to JTF Shining Hope's Camp Hope and Camp Eagle. These dedicated young Marines ensured the continuation of camp construction, without interruption from the local mafia. The security forces reported gunfire outside the camps on a routine basis, and referred to the area as the "Wild, Wild West." Although it was not their mission, the Marine security detail would often process incoming refugees who arrived after hours when the civilian camp administrators had departed for the day. The Marines welcomed these traumatized newcomers, and always ensured they were properly cared for until the official camp administrators arrived in the morning. Warming to the plight of the people in Camps Hope and Eagle, the Marines built a soccer field for the Kosovar children, establishing trust and good will with the encamped refugees.

A small detail of BLT security personnel (57 Marines) was assigned to USS ***Inchon*** (MCS 12), to ensure the safety of their heavy lift MH-53 helicopters, which lacked any self protection capability. The MH-53s delivered humanitarian supplies deep into Albania to the international camps along the border. This small cadre of Marines kept both the criminal elements and desperate refugees in check as vital supplies were delivered to the people in greatest need.

Captain James A. Bolcar (left) Commander, Amphibious Squadron Two and Colonel Kenneth J. Glueck, Commander, 26th MEU(SOC) review disaster relief options. *(Lance Corporal Richard T. O'Connor/USMC)*

In summation, during a typical day in the Adriatic ***Kearsarge*** ARG and 26 MEU(SOC) routinely performed the following missions:

- AV-8B Battlefield Air Interdiction/ Carrier Air Strike (BAI/CAS)
- USMC KC-130s Tanking/Logistics Flights from Bari, Italy
- TRAP/SPARROWHAWK 60-180 minute alert
- Humanitarian Assistance helicopter security detail for ***INCHON*** MH-53s
- Pioneer Unmanned Aerial Vehicle Operations
- Forward Command Element liaison to JTF-SHINING HOPE staff in Tirana, Albania
- Camp Hope security in the vicinity of Fier, Albania
- Camp Eagle security in the vicinity of Fier, Albania
- Ship-to-Shore logistics runs via LCAC and LCU to the USMC security details ashore

The above ARG/MEU Operations in the Adriatic contributed significantly to U.S. efforts in the region, but the most significant contribution by EUCOM 911 was yet to come.

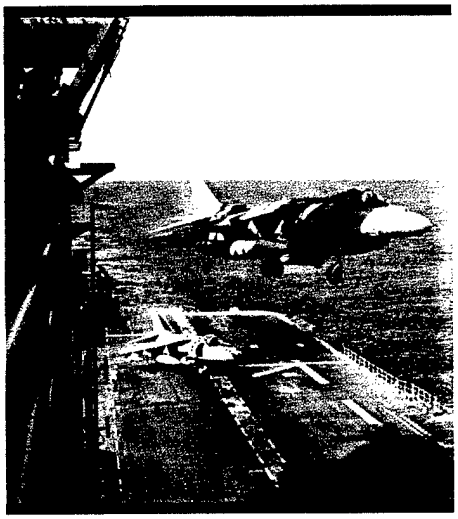
While the crew of ***Kearsarge*** enjoyed some well deserved liberty inport Brindisi, Italy, after 45 continuous days at sea, the dreaded words "Assemble the Crisis Action Team" pounded out over the 1MC. Something big was about to happen. When even the smallest element of the MEU remained ashore, this tight knit group of amphibious planners remained at the ready to support forces ashore or react to any incoming 911 calls. A portion of the MEU ACE (Air Combat Element) had been cross-decked to ***Ponce*** to provide the necessary lifelines inland, while the flagship tied up pierside some 60NM across the Adriatic. Command circuits remained manned and the staff continued to plan for possible tasking as an initial U.S. entry force into Kosovo. The tasking had arrived.

After a long night of intense planning, ***Kearsarge*** left Brindisi the following day and sprinted across the Adriatic to collect the security forces in Camps Hope and Eagle. ***Kearsarge*** ARG and 26th MEU(SOC) had been ordered to proceed to the Aegean as soon as possible to join Operation Joint Guardian. The entire MEU, with all its combat equipment and vehicles,

would transfer ashore to provide the U.S. contribution to Kosovo Forces (KFOR). Here they would join NATO's initial entry force into Kosovo for peacekeeping operations. The Marines providing security to Kosovo refugees in Albania were back-loaded in eight hours and the ARG began a high speed dash to Greece. The MEU would go ashore to provide stability for the return of these same ethnic Albanian refugees to their homes in Kosovo. Forty-nine hours after the completion of the back-load from Albania, the entire combat power of 26th MEU(SOC) lay waiting off the coast of Litokhoron Beach, Greece.

As often happens in matters involving diplomacy at an international level, action was delayed while all parties settled on an agreement. The Military Technical Agreement was signed on 9 June 1999, officially ending the bombing campaign against Serbia. (Greece objected to the bombing campaign and did not allow American entry while it continued.) On the 10th of June, as the world watched live on CNN, the Blue/Green Team flawlessly offloaded 1331 Marines and 185 vehicles in less than 11 hours - a textbook perfect amphibious operation. The following day, forty two hours after commencing the offload, the MEU was operational ashore in a Forward Operating Base near Skopje, Former Yugoslavian Republic of Macedonia. In less than two days, the entire combat power of 26 MEU(SOC), including 1991 personnel with their associated gear were poised on the Kosovo border awaiting entry and the ACE had deployed to field conditions with 22 helicopters. EUCOM 911 was ready for action.

In a bizarre diplomatic twist, the rules by which peace would be enforced called the UCK Undertaking (Ushtria Cleremtare e Kosoves, or in English, the Kosovo Liberation Army Undertaking) would not be signed until 21 June 1999. 26 MEU(SOC)'s initial guidance was to conduct peace support operations in Kosovo, enforce the Military Technical Agreement, and enforce the UCK Undertaking (initially unsigned). The MEU was then assigned to Task Force Falcon (the U.S. component of KFOR) and was further tasked with multiple missions including: providing force protection and a safe, secure environment; supporting humanitarian relief; establishing law and order; and assisting in the re-establishment of civil functions.



An AV-8B Harrier from HMM-266 lands on board USS ***Nassau*** (LHA 4). *(PH1 Richard Rosser/USN)*

In an environment where sniper fire was common, unexploded ordnance made routine travel perilous, and refugees were returning to find their homes occupied by former enemies, this was no small order.

While the finer points of 26 MEU(SOC)'s success ashore are best left to the experts who executed them, the following is humbly submitted as representative of their historic achievements. Static checkpoints were established using the "Strategic Lance Corporal" to make on the spot combat environment decisions. Foot and mobile presence patrols were established for stability. Weapons collection was conducted and proved to be surprisingly effective, 491 rifles, 87 pistols, and 807 other weapons were surrendered to the Marines during the 30 days they remained in Kosovo. Aerial reconnaissance was employed to identify hot spots. The five-man Navy EOD team sent by the ARG Commander to assist the Marines was heavily employed, with each member responding daily to an average of 12 calls per person. Air presence was employed, a hovering attack helicopter often tipped the balance of a tense situation in the MEU Commander's favor. Criminal investigations were conducted. Security for mass grave sites was provided until international investigators could arrive to assess and record the sites. Humanitarian assistance was provided to the needy. Core civil functions were reestablished.

The defining moments of 26th MEU(SOC)'s assignment to TF Falcon follow. On 16 June 1999, 116 UCK were disarmed in a demonstration of the MEU's ability and commitment to enforcing peace, while demonstrating even-handedness to protect both factions. On 17 June 1999, the MEU occupied MUP (Serbian Police) Headquarters in a demonstration of commitment to law and order. On 23 June 1999, a letter of agreement was signed after much negotiation among the MEU Commander and the hospital staff (Serbian and Albanian), which set a precedent for restoring civil functions. 26 MEU(SOC) accomplished its assigned mission with diplomatic and political acumen.

Twenty-sixth MEU(SOC) returned to ARG shipping on 15 July 1999, back-loading through Thessaloniki, Greece in three days. EUCOM 911 left the region for Rota, Spain, to repair equipment and allow

the Marines a chance to gradually return to life away from combat. Perhaps the greatest accomplishment of all was the fact that the entire MEU(SOC) had returned with no loss of life or serious injury. VADM Dan Murphy, Commander Sixth Fleet, had successfully deployed a maritime force to a land-locked nation providing critical initial stability to an operation that continues today.

In August of 1878, while addressing the British House of Lords, Prime Minister Disraeli observed, "No language can describe adequately that large portion of the Balkan Peninsula – Serbia, Bosnia, Hercegovina and other provinces – political intrigues, constant rivalries, a total absence of all public spirit...hatred of all races, animosities of rival religions and absence of any controlling power.:. nothing short of an army of 50,000 of the best troops would produce anything like order in these parts." Unfortunately, over 120 years later, approximately 50,000 of NATO's best troops would bear first-hand witness to Prime Minister Disraeli's observation, as KFOR in the war-weary country of Kosovo.

EUCOM 911 finished recharging its batteries in Rota, Spain, and sailed for Spanish liberty ports in what was to be the last liberty call of the deployment. At 0302, 17 August 1999, a massive earthquake shook Izmit and Golcuk, Turkey. On verbal orders received the evening of 18 August, the ARG/MEU Team sortied the following morning and made yet another high-speed dash to the Aegean Sea – this time ending in the Sea of Marmaris on 22 August. The mission assigned: "In coordination with ODC (the Office of Defense Cooperation), Task Force Avid Response provide disaster relief as required in the vicinity of Izmit/ Golcuk, Turkey in order to support the Government of Turkey."

The official, published death toll would climb to over 17,000 victims and hundreds of thousands would be left homeless in Turkey's industrial heartland. Hundreds of apartment buildings completely collapsed or "pancaked" as a result of poor workmanship, leaving five to ten-foot piles of rubble where once seven story buildings stood. Since the earthquake struck in the early morning hours, the death toll in these buildings was immense. For three weeks, the ARG/MEU Team provided assistance to the people of Turkey in an operation spreading from the American Consulate in Istanbul to the ravaged Turkish Naval Headquarters 60 miles away in Golcuk. Operating from the sea, the ARG/MEU team delivered shelter, water and medical assistance directly to Turkish earthquake victims in the greatest areas of need. (The footprint ashore was deliberately kept to a minimum to reduce the burden on an already devastated infrastructure.)

Specific relief contributions included: the distribution of 3,670 tents and the construction of over 800 family sized (10-20 man) tents for homeless Turkish citizens; the construction of five tent "communities;" the distribution of 18,000 gallons of potable water to areas left without water distribution; the helicopter transport of 2,673 individuals including rescue, survey and technical teams; the helicopter transport of 348,800 pounds of cargo; and the treatment of 703 medical patients and 376 dental patients living in small tent communities. When the ARG/MEU team departed, the remaining supplies, including 2312 tents, 63 toilets and 4 generators, were turned over to the Turkish government for distribution.

Task Force Avid Response utilized the Marine Corps Humanitarian Assistance X-File 3-35.11 as a guide to approaching this immense tasking. This handbook can be found on the U.S. Marine Corps War Fighting Laboratory Web page www.mcwl.quantico.usmc.mil, and is highly recommended as a guide to executing humanitarian assistance missions.

Task Force Avid Response validated the Civil Military Operations Center concept by providing effective liaison to the host nation and focusing U.S. Government efforts. Capitalizing on the ARG/MEU command and control capabilities and the mobility of embarked helicopters, Task Force Avid Response drew upon the MEU's civil-military training and experience employing Marine professional logisticians to organize distribution efforts.

Over the course of a six-month deployment when tasked with missions from Peace Keeping to Humanitarian Assistance, the ARG/MEU Team routinely demonstrated flexibility under demanding circumstances. The proven ability to rapidly and accurately assess situations given limited information then quickly adapt to emerging requirements was imperative to the team's success.

EUCOM 911 completed their deployment soon after the call to Turkey and handed the baton to CPR6 (Commander Amphibious Squadron Six) and 22 MEU(SOC). In March, 2000, the baton was passed again to CPR8 and 24 MEU(SOC) who stand the watch today. At the time of this article's submission, 24 MEU(SOC) was commencing re-entry into Kosovo to assist with NATO's KFOR Peace Keeping efforts. Our thoughts and prayers go out to the men and women who answer the call, EUCOM 911. ■

Editor's Note: LCDR Ochs is the Operations Officer for Commander, Amphibious Squadron Two.

Got a Surface Warfare Problem?

by LT Jim Lowell
& LT Bruce Stanley

The Naval Postgraduate School in Monterey, California is the Navy's school for educating its officers in postgraduate curricula varying from C4I and Combat Systems to National Security Affairs and Operations Analysis. Of all curricula at NPS, Operations Analysis is the problem solving curriculum. Recent OA master's theses have tackled problems from Army boot camp streamlining, to Marine Corps combat logistics simulations, to Naval Aviation mishap rate prediction. But a distressingly small proportion of recent theses have addressed Surface Warfare issues. We believe this is due to an information gap between the "pointy end of the spear" warfighters, with real-world problems, and their fellow SWOs solving problems for their Operations Analysis master's theses.

We first noticed the gap between the fleet and "brain trust" at NPS during a recent brief for OA students nearing our thesis data collection phase. At the time, not one student out of 63 was working on a Surface Warfare issue. No one, including us, was applying their Operations Analysis research effort towards problems that could improve the Surface Warfare community. We are sure that the explanation of this is not that the surface fleet lacks suitable problems. Instead, we think that the problem is simply one of communications.

We arrived in the OA curriculum as fresh-from-the-fleet Surface Warfare Officers with no idea that NPS theses could be used to solve actual fleet problems. We assume neither do the JO SWOs out there – probably reading this magazine in the wardroom, waiting for a stack of sliders. We want to make the Surface Warfare Community aware of the problem solving "lab" in the Operations Research Department and open a line of communication for reporting suggestions for research. This article is the first step in accomplishing that mission. The second step will be for you, the Commanding Officer, Executive Officer, Department Head, Division Officer, Chief Petty Officer, Petty Officer, and Seaman to examine your every day work load. Have you ever said in disgust, "There has got to be a better way to do this!" Are there squadron-wide, or waterfront issues or processes that could be improved, optimized, made more efficient, faster or cheaper? Let us know about them.

While we want to encourage communication, we do have to inject one cautionary note. OA can't help with everything. If you think that the United States would be better off if our Navy's budget were increased, then we sympathize but have to

Try the NPS Head Shed

state that OA won't help much, at least not at the level that a student can realistically undertake in a thesis. OA is more likely to help with operational problems that recur frequently enough to provide some data.

Here are some examples of Operations Analysis problems that have been successfully examined in OA theses in the past.

When a Tomahawk missile must be fired against a target, there is a question as to which ship should launch the missile. Even when the ship is known, there is still a question as to which one of the available missiles should be launched. The selection problem is sufficiently important and difficult that FC1(SW) Robert Pratt, Leading Petty Officer, Strike Division, USS O'Bannon DD-987, was once heard to say:

"We received a new program to help with missile selection. It sucks! Anyone can do a better job. I called California to tell them about it, but it seemed to me they didn't care, so to hell with it, we'll continue to do it the old way."

Fortunately Pratt's comment came to the attention of LT Scott Kuykendall, who subsequently undertook the challenge to provide a better method in his thesis *Optimizing the Selection of Tomahawk Cruise Missiles.* Kuydendall's thesis was followed by several other OA theses on the same subject, and in sum they are influencing the design of the TTWCS software produced by the Naval Surface Warfare Center, Dahlgren Division.

Big as an aircraft carrier is, it is not easy to follow one safely, particularly at night. Accidents have occurred, and they are dangerous as well as expensive. LCDR Thomas V. Evanoff II had the idea of introducing Tactical Vectoring Equipment (TVE), a system of Fresnel lights at the back of an aircraft carrier that would permit any ship in a plane guard station to infer sudden changes of heading. Evanoff designed a virtual experiment in the Operations Research department's Human Systems Integration Lab using his fellow students as subjects to show that TVE lights simplify the task of station keeping. His thesis Analysis and Design of a Shipboard Visual Navigation Aid for Vessels in Formation showed statistically that TVE lights are effective. VADM Giffin (COMNAVSURFLANT) describes Evanoff's work as "a great example of how Surface Warfare Officers who are sent to NPS can benefit the surface community and Navy overall."

Here are four more examples of recent Surface Warfare related theses:

Advanced Naval Surface Fire Support Weapon Employment Against Mobile Targets,
LT Hung Le, December, 1999.

Optimizing Ordnance Loadout of Navy Surface Combatants Operating in Support of Naval Surface Fire Support,
LT Stanfield Chien, USN, September 1997.

Naval Task Force Anti-Ship Missile Defense,
LCDR James R. Townsend, USN, February 1999.

A Predictive Model of Surface Warfare Officer Retention: Factors Affecting Turnover,
LCDR Greg Gjurich, March 1999

We could give more Surface Warfare examples, but they would still be a small proportion of the approximately 50 OA theses that are completed here every year. If you have an idea, email it to the OA curricular office at code30@nps.navy.mil, being sure to include points of contact. There are no guarantees, since thesis topics are chosen by students rather than assigned to them, but we will log your Surface Warfare issues and POC's in a database for upcoming OA students to browse.

The same email address would be equally good if you are interested in graduate education yourself. The OA curriculum and its companion Operational Logistics (OL) curriculum are both seven quarter curricula leading to a master's degree in Operations Research. What do you think of the idea of lengthening the curriculum to eight quarters while bundling JPME Phase 1 certification into a single two-year shore tour, an idea that is currently under consideration? If you have an opinion, Code 30 would like to hear from you on that, too.

For information on the Operations Research Department or the Naval Postgraduate School, visit: **www.nps.navy.mil.**
Visit **http://web.nps .navy.mil/~opnsrsch/oacurric/projects-table.htm** to see the current list of potential thesis topics, the one that we claim does not have enough Surface Warfare operational issues in it. For an NPS catalog, write to:

Director of Admissions
Code 01B3
Naval Postgraduate School
Monterey, CA 93940-5100

Editor's note: LT Jim Lovell and LT Bruce Stanley are students at the Naval Postgraduate School in Monterey, Calif., and are currently enrolled in the Operational Analysis masters degree program.

SHIP IN THE SPOTLIGHT

USS Cushing

Cushing Renders Honors in Style

by ENS Steve Lowe, USS ***Cushing*** Public Affairs Officer

"May we not who are of their brotherhood claim that in a small way at least we are partakers of their glory? Certainly it is our duty to keep these traditions alive and in our memory, and to pass them on untarnished to those who come after us." *RADM Albert Gleaves, USN*

It is as if these words were piped across the decks and through the passageways of USS *Cushing* (DD 985) on the beautiful, crisp, morning of April 12, as she entered Hobart Harbor, in the state of Tasmania, Australia. *Cushing* embraced this spirit and instilled a sense of history and tradition in her crew, while extending a salute to Sir Guy Green, the governor of Tasmania, Australia. *Cushing* entered Hobart Harbor at 7 A.M. and conducted a smart, fast figure eight and salute in the harbor in memory of the "Dido" maneuver RADM Magruder conducted in Hobart 75 years ago with a division of light cruisers. RADM Magruder's actions are captured in the naval institute press' scholarly study, Naval ceremonies, Customs, and Traditions, by VADM William Mack, USN, and LCDR Royal Connell, USN.

"In 1925, Admiral Magruder. Executed as a mark of respect to the governor of Tasmania, a very difficult naval evolution at high speed, both upon entering and leaving Hobart, Tasmania. It might have been called 'Cutting a Dido,' but the smart effect of the division of light cruisers in rendering this exceptional honor was taken as a compliment to the governor and much appreciated by the inhabitants. Such things are long remembered." LTjg Justin Long, of Sacramento, CA, proposed *Cushing* recognize these pioneers of the U.S. Navy's Pacific Fleet by conducting maneuvers and a salute in Hobart Harbor. "My first challenge was developing a maneuver that captured the spirit of a light cruiser, while recognizing *Cushing* is significantly larger, with a much deeper draft," LTjg Long explained. "The favored form of conducting a Dido is for two or more ships to swap stations simultaneously, driving reciprocal circles and maneuvering close aboard. *Cushing*, as a single ship, conducted a figure eight at 17 knots, using a full rudder, in sight of the downtown wharves." These maneuvers were conducted immediately prior to mooring, with the crew paraded at quarters for entering port. Immediately upon securing from the maneuver, the crew marched smartly and professionally to their manning-the-rail stations. *Cushing* then moored at Macquarie Wharf in downtown Hobart. A special brief was conducted the evening before, to ensure the ship would safely execute the maneuver. Permission was received from CDR Harry Finnis, the senior Royal Australian Navy (RAN) officer, Tasmania. The maneuver and salute were very well received, indeed cheered, by the official party awaiting *Cushing*'s arrival. Further commemorating the event,

"How superb it is that ***Cushing*** would remember an event that occurred 75 years ago. It is a tribute to the lasting nature of the American-Australian friendship to know that the camaraderie and spirit of cooperation that existed in 1925 is still strong 75 years later."

– Sir Guy Green, Governor, Tasmania, Australia

Cushing's Commanding Officer, CDR Martin S. Simon, of the Bronx, NY, presented a picture of *Cushing* to Sir Guy Green. Embossed over the picture was the quote describing RADM Magruder's maneuvers in Hobart Harbor. The picture was another fitting remembrance of his 1925 visit and salute. The governor was impressed by the gesture and specifically noted, "how superb it is that *Cushing* would remember an event that occurred 75 years ago. It is a tribute to the lasting nature of the American-Australian friendship to know that the camaraderie and spirit of cooperation that existed in 1925 is still strong 75 years later." *Cushing*'s actions upheld the highest traditions of the United States Navy. The superb contributions of one of our early leaders was recognized, the long history of forward presence was re-affirmed, our lasting friendship with Australia was celebrated, and smart professional seamanship and shiphandling were valued. While *Cushing*'s wake quickly dissipated, the spirit and impact of a Hobart Harbor Dido will remain in the heart of her sailors and the citizens of Hobart forever.

Editor's Note: USS Cushing, *commanded by Commander Martin S. Simon, of the Bronx, New York, is a Spruance-class destroyer forward deployed to Yokosuka, Japan as a member of the U.S. Seventh Fleet.* ■

Changes of Command

SURFLANT

USS *Nassau* (LHA 4)
CAPT Gerard M. Mauer, Jr. relieved
CAPT Ronald Chapman

USS *Supply* (AOE 6)
CAPT Robert S. Warner relieved
CAPT Joe N. Stafford

USS *Ponce* (LPD 15)
CDR Mark J. Murphy relieved
CDR Christopher B. Chance

USS *Trenton* (LPD 14)
CDR Brian A. Goulding relieved
CDR James A. Murdoch

USS *Samuel Elliot Morison* (FFG 13)
CDR Frederick P. McKenna, Jr. relieved
CDR Mark D. Klatt

USS *Simpson* (FFG 56)
CDR Randall G. Bowdish relieved
CDR Gerald F. Deconto

USS *Comorant* (MHC 57)
LCDR Steven A. Muchlow relieved
LCDR Scott C. Stuart

SURFPAC

USS *Bonhomme Richard* (LHD 6)
CAPT Robert J. Connelly relieved
CAPT Douglas W. Keith

USS *Bunker Hill* (CG 52)
CAPT Robert A. Butt relieved
CAPT Patrick L. Denny

USS *Paul Hamilton* (DDG 60)
CDR Dennis J. O'meara relieved
CDR James K. Hiser

USS *Sacramento* (AOE 1)
CAPT David H. Buss relieved
CAPT Allen G. Myers

USS *David R. Ray* (DD 971)
CDR Todd W. Malloy relieved
CDR Clifton E. Perkins

SITREP

Sailor at sea is the 100,000th to get SMART Transcript

PENSACOLA, Fla. - On February 22, Petty Officer 2nd Class Christopher Randall Louk became the 100,000th Sailor to request and receive his SMART (Sailor/Marine American Council on Education Registry Transcript). Louk was underway on board the USS ***McFaul*** (DDG-74) homeported in Norfolk, Virginia, when he accessed the Navy College Program Web site (www.navycollege.navy.mil) to get a copy of his SMART online. The SMART is a feature of the new Navy College Program. It documents recommended college credit for a Sailor's military training and occupational experience.

"We were at quarters on board the ship when our chain of command informed us about the SMART, so I decided to go to the Navy College Program web site and check it out," explained Louk. "I went to the site, filled in the requested information, and found out that I had a total of 63 recommended college credits from the Navy schools that I had attended. Later that day the ship received an e-mail informing them that I was the 100,000th requestor."

Louk is a Gas Turbine Systems Electrician and works on most of the electronics for the ships engineering plant. He also performs mechanical maintenance in engineering on the main engines and generators. He has been in the Navy for nearly three years and graduated from Elkins High School in his hometown of Elkins, West Virginia.

◀ GSE3 Christopher R. Louk, stationed on board USS ***McFaul*** (DDG 74) currently deployed in the Mediterranean Sea, researches how much college credit he has earned from his naval training through the SMART system as his commanding officer CDR Bruce H. Curry and division officer CWO2(SW) Greg Galyo look on. (USN)

"I like the SMART because it allows Sailors to get an idea of what they have accomplished since the start of their career in the Navy," said Louk. "It also allows someone to see how his or her accomplishments relate to obtaining a college education. Louk said that many of the sailors aboard USS ***McFaul*** are using the Navy College Program web site to get their transcripts.

Louk's future plans are to get a Bachelors of Science degree in Electrical Engineering. He already has a degree in Exercise Physiology.

The following procedures should be followed to obtain an individual unofficial SMART via the Navy College Program web site:

- go to the Navy College Program Web site at www.navycollege.navy.mil
- click on "here" to get your SMART.
- click on "Sign into SMART as an individual."

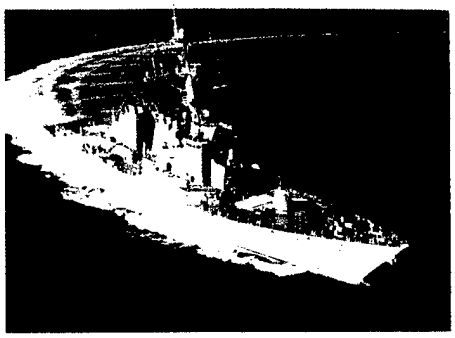
You will now be on the page to enter your SSN and password. If you have never requested a SMART, enter SSN only. The system will bring up another screen for first time users, to enter additional personal information.

- You will need your pay entry base date, located on your leave and earning statement (LES) to access your transcript.

While SMART is now available online, Sailors and Marines may still request copies from the Navy College Center by calling 1-877-253-7122/ DSN 922-1828, via e-mail at ncc@smtp.cnet.navy.mil or by visiting their local Navy College Office. Your official SMART transcript can be sent directly to an academic institution of your choice, and must be requested from the Navy College Center or by visiting your local Navy College Office.

Aegis Destroyers Complete Historic Missile Firing Exercises

The Navy achieved an historic milestone recently when its latest, most modern and capable warships, ***Oscar Austin*** (DDG 79) and ***Roosevelt*** (DDG 80) successfully intercepted drone targets during back-to-back missile firing exercises. Culminating almost six years of engineering, shipbuilding and testing efforts, this historic milestone marks the first missile launches on an Arleigh Burke Flight IIA-



class Aegis destroyer using the Navy's most technologically advanced computer program-designated Baseline 6 Phase 1.

Both ***Oscar Austin***, built by Bath Iron Works (BIW) of Bath, Maine, and ***Roosevelt***, built by Litton Ingalls Shipbuilding of Pascagoula, Miss., are in the test and trials phase of their respective shipbuilding programs. ***Oscar Austin*** completed the missile firing exercise during the ship's combat systems sea trials conducted the week of 20 March. Similarly, ***Roosevelt*** completed her missile firing exercise during combat systems sea trials the week of 27 March.

President nominates ADM Clark as next CNO

Washington (NNS) — Secretary of Defense William S. Cohen announced April 3 that the President has nominated ADM Vern E. Clark for appointment to the grade of Admiral and assignment as Chief of Naval Operations, Washington, D.C. Admiral Clark is currently serving as Commander in Chief, U.S. Atlantic Fleet, Norfolk, VA. Commenting on the announcement, Chief of Naval Operations ADM Jay L. Johnson said, "I am tremendously pleased that the President has nominated Admiral Vern Clark to be the next Chief of Naval Operations. He is an officer of outstanding character, keen intellect and broad operational experience who cares deeply about our men and women in uniform and their families. He will be a superb Chief of Naval Operations." To learn more about ADM Vern Clark, go to: www.atlanticfleet.navy.mil/cincbio.htm.

< Ship's sponsor Zandra M. Krulack, wife of General Charles C. Krulak, USMC (Ret.), former Commandant of the Marine Corps, smashes the ceremonial bottle of champagne across the bow of the USS ***Iwo Jima*** (LHD 7), the U.S. Navy's newest multipurpose amphibious assault ship, during christening ceremonies March 25 at Litton Ingalls Shipbuilding in Pascagoula, Mississippi. Observing Mrs. Krulak are, from left, the ceremony's Matrons of Honor, Carolyn Penrose Krulak and Elizabeth Parsons Krulak, and Ingalls' Special Projects Manager, Cheri Cole. LHD 7 will enter service with the U.S. Atlantic Fleet when commissioned in mid-2001. *(Ingalls Shipbuilding Photo)*

Correction

In the March/April Issue of Surface Warfare, VADM Hank Giffin and VADM Edward Moore were misidentified as Com-manders-in-Chief Atlantic and Pacific Fleets, respectively. They should have been identified as Commanders Naval Surface Force Atlantic and Pacific Fleets, respectively.

◀ USS *Chancellorsville* (CG 62)

On Station

USJFCOM

USS ***Arthur W. Radford*** (DD 968)
USS ***Barry*** (DDG 52)
USS ***Dallas*** (SSN 700)
USS ***Grasp*** (ARS 51)
USS ***H.G. Rickover*** (SSN 709)
USNS ***Laramie*** (TAO 203)
USS ***Oklahoma City*** (SSN 723)
USS ***Shreveport*** (LPD 12)
USS ***Thunderbolt*** (PC 12)
USS ***Whirlwind*** (PC 11)

USPACOM/3rd Fleet

USS ***Fife*** (DD 991)
USS ***Jarrett*** (FFG 33)

USCENTCOM/5th Fleet

USS ***Ardent*** (MCM 12)
USS ***Asheville*** (SSN 758)
USS ***Bon Homme Richard*** (LHD 6)
USS ***Bridge*** (AOE 10)
USNS ***Catawba*** (TATF 168)
USS ***Denver*** (LPD 9)
USS ***Elliot*** (DD 967)
USS ***John C. Stennis*** (CVN 74)
USS ***Laboon*** (DDG 58)
USS ***Lake Champlain*** (CG 57)
USNS ***Niagra Falls*** (TAFS 5)
USS ***Pearl Harbor*** (LSD 52)
USS ***Port Royal*** (CG 73)
USS ***Rentz*** (FFG 46)
USS ***Samuel B. Roberts*** (FFG 58)
USS ***The Sullivans*** (DDG 68)
USNS ***Tippecanoe*** (TAO 199)

USEUCOM/6th Fleet

USS ***Anzio*** (CG 68)
USNS ***Apache*** (TATF 172)
USNS ***Big Horn*** (TAO 198)
USS ***Cape St. George*** (CG 71)
USNS ***Concord*** (TAFS 5)
USS ***Dwight D. Eisenhower*** (CVN 69)
USS ***Emory S. Land*** (AS 39)
USS ***Hartford*** (SSN 768)
USNS ***Kanawia*** (TAO 196)
USS ***Kaufman*** (FFG 59)
USS ***Mahan*** (DDG 72)
USS ***Minneapolis St. Paul*** (SSN 708)
USNS ***Mount Baker*** (TAE 34)
USS ***Oak Hill*** (LSD 51)
USNS ***Patuxent*** (TAO 201)
USNS ***Sirius*** (TAFS 8)
USS ***Springfield*** (SSN 761)
USS ***Taylor*** (FFG 50)
USS ***Trenton*** (LPD 14)
USS ***Wasp*** (LHD 1)

USPACOM/7th Fleet

USS ***Belleau Wood*** (LHA 3)
USS ***Blue Ridge*** (LCC 19)
USS ***Chancellorsville*** (CG 62)
USS ***Charlotte*** (SSN 766)
USS ***Curtis Wilbur*** (DDG 54)
USS ***Cushing*** (DD 985)
USS ***Decatur*** (DDG 73)
USNS ***Flint*** (TAE 32)
USS ***Fort McHenry*** (LSD 43)
USS ***Frank Cable*** (AS 40)
USS ***Gary*** (FFG 51)
USS ***Germantown*** (LSD 42)
USS ***Guardian*** (MCM 5)
USS ***Jefferson City*** (SSN 759)
USS ***John S. McCain*** (DDG 56)
USS ***Juneau*** (LPD 10)
USS ***Kitty Hawk*** (CVN 63)
USS ***Mobile Bay*** (CG 53)
USS ***O'Brien*** (DD 975)
USNS ***Rappahannock*** (TAO 204)
USS ***Safeguard*** (ARS 50)
USS ***Salt Lake*** City (SSN 716)
USS ***San Jose*** (TAFS 7)
USS ***Topeka*** (SSN 754)
USS ***Vandegrift*** (FFG 48)
USS ***Vincennes*** (CG 49)
USNS ***Walter S. Diehl*** (TAO 193)
USNS ***Yukon*** (TAO 202)

USSOUTHCOM

USS ***Black Hawk*** (MHC 58)
USS ***Defender*** (MCM 2)
USS ***Doyle*** (FFG 39)
USS ***Estocin*** (FFG 15)
USS ***Hue City*** (CG 66)
USS ***John A. Moore*** (FFG 19)
USS ***Kingfisher*** (MHC 56)
USS ***Robert G. Bradley*** (FFG 49)
USS ***Robin*** (MHC 54)
USS ***Samuel Elliot Morison*** (FFG 13)
USS ***Sentry*** (MCM 3)